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Electromagnetic Machinery.

ELSEWHERE in our columns this week may be found the first portion of a study of electromagnetic machinery, by Mr. W. S. Aldrich. Much has been written on dynamos and motors, on electrical systems and on the transmission of power, but it is exceedingly satisfactory to have brought out, as Mr. Aldrich has done in this paper, the correlation of electromagnetic with other mechanisms. This point of view is a very useful one in the consideration of many problems and ought to be taken oftener than it is, for it simplifies many considerations that otherwise might prove puzzling. Particularly is it advantageous in studying the electrical transmission of power, for here electricity is brought most closely into comparison with ordinary mechanical methods. At present, when the subject of electric power is every day receiving more and more attention from engineers, a clear understanding of its relation to other means of transmitting power is especially useful. We are already familiar with the hydraulic analogies of electric current and with a few of its general mechanical analogies, but Mr. Aldrich has done good service in collecting and systematizing the subject considered from the point of view of the mechanical engineer rather than from that of the pure electrician.

Edison and Thomson-Houston Combination.

VAGUE rumors of a proposed consolidation of the Edison and Thomson-Houston companies have been drifting about for the past two weeks, and these have now taken such shape as to indicate that this union of interests is practically an accomplished fact. The combination promises to be not a mere commercial union, but a genuine amalgamation of these two great companies under a single management. It is generally understood that Mr. C. A. Coffin, who has successfully piloted the Thomson-Houston Electric Company, will be put at the helm of the consolidated company. With this union of the forces of the two largest electrical corporations in America, there will come into existence an organization so powerful as to be assured of the practical control of a large portion of the electrical business. On the whole the effect of this is likely to be good, for from time to time the electrical business has felt the unpleasant effects of too great competition. The immediate reduction of prices produced thereby is grateful to the general public, but the tendency is to secure it by work less thorough and less satisfactory than would be the case were the margin of profit somewhat greater. With the conscientious and able management the new company is likely to have, we may look forward with confidence to careful and painstaking work, and the stability brought by it into any and every department of industry. The general terms of the consolidation are given elsewhere in our columns, and the character of the committee of reorganization is ample guarantee of honest and straightforward purpose.

A Brilliant Lecture from Mr. Tesla.

WE are pleased to note in the cable dispatch this week the cordial reception of Mr. Tesla in England, and the widespread interest attracted by his extraordinary experiments shown in the lecture at the Royal Institution. Our readers will remember the excitement caused by the first exhibition of his remarkable work before the American Institute of Electrical Engineers, as well as the preliminary account of his wonderful experiments that was published in THE ELECTRICAL WORLD very nearly a year ago. Mr. Tesla has opened a new field of electrical research, one which promises both important theoretical and practical results. Sensational as some of the experiments appear, Mr. Tesla is persistently working in the direction of their practical application, never losing sight, in the brilliancy of the theoretical possibilities, of the application of the principle involved to the service of mankind. It is difficult now to estimate the value of his researches, for as yet much of his most important work has not been made public, but his friends know and appreciate the intensely practical turn that his later work has taken. Mr. Tesla has for some years worked very quietly and unostentatiously, and it is only recently that the world has waked up to the importance of what he has accomplished.

A Proposed High Speed Railway.

SOMETHING of a sensation has recently been created by the proposition to construct at once an electric railway between St. Louis and Chicago to cover the 250 miles of distance between those two cities at the rate of something like 100 miles per hour. The proposition comes from St. Louis, and is backed by St. Louis interests, while the electrical head of the enterprise is Dr. Wellington Adams, who was one of the early experimenters on electric motors for railway purposes, and some of whose patents have recently attracted public attention. As yet nothing more definite can be said than that the road is proposed. Some of the details that have appeared in the newspapers show somewhat more audacity in conception than most conservative electricians would approve. To operate 250 miles of track from a single power station is not a task lightly to be undertaken, and unless an alternating motor more effective than any which have yet appeared should be among the improvements of the near future the scheme is not even plausible. Another novel idea which causes the conservative to look askance at the whole matter is the construction of a boulevard along both sides of the track for the entire distance between Chicago and St. Louis. This is a plan that is worthy the impecunious representative of an alleged English syndicate. We sincerely hope, in the interests of electrical science, that our Western friends will carry their enterprise to a successful conclusion, but there are still many difficulties to be overcome and so colossal a feat in electrical engineering cannot be accomplished by furnishing imposing offices and selling stock.

Electric Fire Alarms.

THE recent disastrous fire at the Hotel Royal in this city emphasizes very forcibly the desirability of extreme precautions in the hotels and apartment houses which are so numerous in every large city. Much of the loss of life on this latest occasion is ascribed, and probably with good reason, to the loss of perhaps ten minutes in sending an alarm of fire. Once received, the Fire Department was on hand, and in an incredibly short time had done everything it was in human power to do to rescue the inmates of the burning building, who were, however, only awakened when the flames were almost bursting into their rooms. It is such a simple matter nowadays to take precautions against such a terrible surprise that it is really extraordinary that they are not more frequently adopted in the towering buildings of the metropolis. It is quite possible—indeed very easy—so to equip a building with automatic apparatus that a fire could not gain appreciable headway without ringing a bell in every room in the house and instantly notifying the office of the impending disaster. In fact an occasional hotel is so equipped. One catastrophe such as that which has just happened ought to serve as an example and lead to the utmost vigilance against any similar occurrence. Once in a while a hotel is so well constructed that a fire cannot spread rapidly, and ample opportunity is given for the escape of the inmates, but in most cases the halls are narrow and tortuous, and the stairs are altogether too near to the elevator shaft for safety. The fire escapes as at present constructed are generally as inadequate as the life preservers on a North River ferry-boat. So long as means are at hand for giving prompt warning of a fire to both the Fire Department and the guests, a pitiful and almost criminal economy is the best excuse that can be offered for not employing them in every building where scores of human lives may be lost by a delay of a few minutes in discovering and announcing fire.

Work of the Patent Office.

THE report of the Commissioner of Patents for the year 1891 is a most interesting document, both as a record of what has been accomplished, and as suggesting improvements in practice that would be of no little importance to inventors and to the public. During the last year there were granted patents, including design patents, to the number of 21,236 to the citizens of the United States, together with nearly 2,000 additional granted to foreigners. One of the most striking facts with reference to this evidence of American inventive genius is the geographical distribution of these patents over the country. As might be expected Yankeedom stands at the head of the list in the number of inventions compared with the population, and, as might also be anticipated, Connecticut—the home of the wooden nutmeg and the papier-maché ham—stands pre-eminent among the States, with Massachusetts an exceedingly good second. In the Southern States the art of invention does not flourish, reaching its lowest degradation in South Carolina, where there was only one patent issued last year to more than 23,000 inhabitants, as against very nearly one to 1,000 in Connecticut. Another very interesting feature of the report shows graphically the growth of invention as compared with the population of the country. Up to 1850 progress was slow, but at that epoch the industrial spirit seemed to seize upon the American people, and invention began to increase. There are two periods in the last half century when inventors were stirred to extraordinary activity; one of these was during the civil war, from 1860 to 1866, during which time the number of patents issued considerably more than doubled, the result, doubtless, of the stimulation of inventions concerning the arms and munitions of war. One other such tremendous increase in invention is to be noted, and its cause can almost with certainty be ascribed to the advent of electricity as a factor in human industry. It began in 1879, and lasted some four or five years. It was during this period that electric lighting, motive power, and all kindred branches of applied science were growing most rapidly, and the effect of this on the work of the Patent Office is indeed most marked. So much for a little view of what the Patent Office has done. At present it is overcrowded with work, and an extra force of examiners is needed. The patent suits of the last half dozen years have brought to public notice a considerable number of points in Patent Office procedure and Patent Office law which ought to be changed for the mutual benefit of inventors and the public. The Commissioner makes several valuable and important suggestions, which, if carried out, would be most salutary in their effect. First among them is the proposition that two years of publication—either in a patent or otherwise—act as a bar to any attempt to secure a patent for the thing involved. Two years of public use are now required, and the determination of what is public use is a source of almost endless difficulty. If publication constituted a similar bar a vast deal of litigation would cease, and we should not be treated to the spectacle of patents granted for things which have long been known if not persistently used. Two other provisions would be peculiarly useful in application, one of them abrogating the now existing law that the expiration of a prior foreign patent invalidates the American patent. If coupled with suitable time limits set upon the application for American and foreign patents this would enable American inventors to take advantage of the longer term of life of American patents without sacrificing them by short-term foreign patents, or by neglect to comply with some of the conditions imposed upon the patentee in other countries. The other important amendment suggested is that no patent shall in any case live for more than 20 years from the date of the first application, joining to this provision one shortening the time allowed for action upon applications. Such a law would effectually prevent the abuses of patent office practice that have of late been forced into unpleasant prominence, by compelling rapid action on the part of litigants. Occasionally this might work injustice to one of them, but, as a rule, it would be equally fair for all parties concerned and would not only diminish the period of exasperating and expensive litigation, but would prevent the public being imposed upon by deliberate efforts to keep applications pending in the office. Still other propositions looking to patent reform are made by the Commissioner, but these are of so much practical value that they deserve especial commendation. As a whole they are just to the inventor and will tend to check the abuses of patent law that at present render the patents themselves of questionable value—except to the litigious. Another provision that increases the definite importance of a patent that has been granted and tends to check applications made in questionable faith should be cordially greeted by every inventor and every reputable patent attorney in the country; the opinion of patent sharks need scarcely be taken into account.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

LONDON, Feb. 8, 1892.—Nikola Tesla's lecture before the Institution of Electrical Engineers was delivered last Wednesday evening at the rooms of the Royal Institution. An audience of 800 greeted the lecturer. Among those present were Lord Rayleigh, Professors J. J. Thomson, J. A. Ewing, J. A. Fleming, Dewar, W. Crookes, W. E. Ayrton and J. Perry, Dr. Gladstone, Mr. G. Kapp, Mr. W. H. Preece, Mr. Mordey, Mr. J. Swinburne, and many other well-known electricians. The lecture occupied over two hours, and the experiments were of a character to call for unusual attention. So striking were they that extraordinary notice was taken of the lecture in the daily papers, and the *Times* devotes its first leading article of a column's length to a very admirable discussion of Mr. Tesla's work. The lecture was repeated on the following evening for the benefit of the members of the Royal Institution. Seldom have more impressive experiments been witnessed at the Royal Institution, which has been the scene of so much brilliant work.

On Wednesday last there was a very successful official trial of the Sims-Edison torpedo off the Isle of Wight.

A bill has just been deposited in the House of Commons authorizing the construction of another underground electric road under the River Thames. The total length of the proposed route is a little over three miles, and the estimated cost is nearly £1,000. It will be practically a duplicate as to arrangement of the City & South London Railway that has now been in successful operation for more than a year.

Consolidation of the Edison and Thomson-Houston Companies.

The most important news of the week is the official announcement of the proposed consolidation of these two companies. The following is the proposed stockholders' agreement appointing a committee to carry out the plan for consolidating the Edison General Electric Company and the Thomson-Houston Electric Company:

Whereas, It is proposed to form a corporation authorized among other things to manufacture, develop and use electricity and electrical apparatus and to acquire patents, and for the transaction of business properly connected therewith or incident thereto, such corporation to have a capital stock of $50,000,000, divided into 500,000 shares of $100 each, of which not more than 20 per cent. may be preferred stock, entitled in each year to receive dividends amounting to seven per cent. cumulative, but without any further right of participation in the profits, and without preference as to principal, such corporation, for the purposes of its business, to have the right among other things to acquire stock, property and rights of other corporations or individuals.

And certain stockholders of the Edison General Electric Company of New York, or of the Thomson-Houston Electric Company of Connecticut, being willing and desiring to the extent indicated in the several subscriptions hereto or by their deposit in conformity herewith as hereinafter provided, to promote and participate in such corporation; now each of them hereby agreeing for himself and not for any other, they do hereby mutually promise and agree as follows, viz.:

(1.) Each subscriber will deposit with the New York Guaranty and Indemnity Company of New York or the Old Colony Trust Company of Boston, as a depositary, in exchange for suitable trust receipts, the number of shares of stock indicated and subscribed in his subscription hereto. All stock deposited hereunto shall be held, used and applied for the purposes of this agreement. In case a majority of the stock of the Edison General Electric Company, and also of the Thomson-Houston Electric Company, shall not have become subject to this agreement on or before May 1, 1892, either by subscription or by a deposit of stock on the terms and for the purposes herein specified, or by both such subscription and deposit, or in case this agreement shall have been declared terminated as hereinafter provided, then and in either of such events, the respective depositaries shall return to the holders of the receipts issued by them respectively the stock represented by such receipts or an equal amount of like stock.

(2.) After such stock shall have been deposited on the terms, and for the purposes of the agreement, the said depositaries shall transfer and deliver the same to such new corporation for account of the holders of such trust receipts therefor in exchange for full paid shares of its stock at the par value thereof, in the manner and at the rate following, to wit:

(*a*) Shares of the stock of the Edison Company shall be exchanged in full payment for shares of common stock in the new corporation, share for share.

(*b*) Shares of preferred stock of the Thomson-Houston Company shall be exchanged in full payment for shares of preferred stock of the new corporation, at the rate of four shares of the old stock (par $25 each) for one share of the new (par $100 each).

(*c*) Shares of common stock of the Thomson-Houston Company shall be exchanged in full payment of common stock of the new corporation at the rate of five shares of the old stock for three of the new.

The new stock shall be delivered to the holders of trust receipts for the old stock at the rates above stated upon surrender of such trust receipts. All dividends hereafter declared on account of any deposited stock shall be treated as belonging to and part of such stock.

After the issue of the stock of the new corporation, as required for the purposes above stated, further issues shall be made only for the general purposes of the company.

(3.) This plan so far as concerns the subscribers, and any and all stock deposited hereunder, shall be carried out under the direction of a committee, to consist of the following persons: J. Pierpont Morgan, D. O. Mills, H. McK. Twombly, Frederick L. Ames, T. Jefferson Coolidge and Henry L. Higginson. Such committee is hereby authorized and empowered to act by a majority to fill vacancies and to devise and carry out such measures as it shall in its discretion select to accomplish the purposes of this agreement, including the formation or organization of such a corporation and the selection of its corporate powers; and with power to decide as to all questions arising under this agreement and for the purpose of carrying out this agreement to direct the transfer by the depositaries of the stock deposited hereunder and to transfer to the name of itself or its nominee all trust, all such stock, with the right to vote thereon. No member of the committee shall be liable except for gross negligence on his own part. The committee shall also have power by the unanimous vote of all its members at any time before the actual exchange of deposited stock for new stock to declare this agreement terminated, and thereafter it shall cease to be operative.

(4.) Instead of a new corporation, any existing corporation may, in the discretion of the committee, be selected and reorganized so as to provide for the substantial accomplishment of the purposes of this agreement, and in that event the exchange of stock shall be made in the ratio above provided. The committee may also fix and publish a date, after which no stock or stockholder not theretofore party hereto shall have any right to come in under this agreement, except by express permission of the committee on such terms as it may impose.

(5.) Each subscriber hereto shall deposit stock hereunder within ten days after a notice calling for such deposit shall be published by the committee in one paper of general circulation in the city of New York, and one in the city of Boston, and in default of such deposit the rights of such subscriber shall, at the discretion of the committee, cease and determine.

(6.) This agreement may, for convenience, be signed in several parts and copies by the subscribers hereto, with like force and effect as if all the signatures were put to one copy thereof. The deposit of stock and the acceptance of trust receipts shall constitute such depositors parties hereto with the same effect as though they had signed this agreement.

Elements of Practical Electricity.*

BY DR. LOUIS BELL.

THE WHEATSTONE BRIDGE.

In using the Wheatstone bridge you will soon become familiar with the various manipulations required for the exact measurement of resistances, but occasionally little difficulties will be met. In setting up the apparatus care must be taken not to get near any considerable mass of iron, and especially to avoid proximity to steam and gas pipes, the magnetic action of which is sufficient to bother you continually in trying to use a sensitive galvanometer. Steam pipes are particularly bad because their magnetic qualities vary enormously as they are in the process of heating and cooling, and it will be quite impossible to keep your galvanometer in adjustment near them. One thing you will often have occasion to notice in measuring the resistance of pieces of wire, especially if they are coiled up, is that you will be able to find no position of the sliding key at which the spot of light reflected from the galvanometer mirror will remain quite steady whether contact is made or not. Instead of remaining quiet the spot of light will give a little sharp movement to one side, and then come back again. In case you encounter this phenomenon you will have to watch the position of the spot of light on the scale carefully and shift the sliding key until the spot comes to rest in the same position whether the key is closed or open. The cause of this annoying little kick of the mirror in making measurements is the fact that a coiled wire does not behave precisely like a straight wire with reference to transmitting a sudden rush of current such as is produced when the contact key is closed.

Your resistance coils are wound "non-inductively," as it is called, that is, the wire is doubled on itself before being wound. Although you may make a plain spiral of wire of exactly the same resistance in reality, it will behave a little differently when placed in the bridge, owing to the fact that it is coiled so that the current circulates around the spiral in the same direction. You will find this especially noticeable in attempting to measure the resistance of one of your magnetizing solenoids.

After a little practice you will find that the rough resistance coils you have constructed are not quite enough to enable you to measure readily all the things which you would like to, and you would, therefore, do well to construct some resistances with considerable care.

*Continued from THE ELECTRICAL WORLD of Feb. 6, 1892.

MAKING RESISTANCES.

Procure for your materials some thin sheet copper, a couple of dozen very small brass screws, and a couple of hundred feet of German silver wire, in size about No. 25. You must have one standard coil, by comparison with which you can make your own resistances. You may be able to borrow a resistance box long enough to make your coils, or to take one of the coils which you already have and get it accurately measured on some standard testing set. If you cannot do this you may have to get a single ohm coil from some instrument maker. This should cost less than five dollars, although the maker will very likely want to sell you a far more expensive one. You are not after the highest exactness, however, as in case this is desired it is only necessary to know the errors of your various resistance coils exactly, even although not one of them is without an error. In fact for delicate work you are obliged to introduce a correction for the temperature of your resistance coil, however exactly it may be adjusted.

Having obtained a coil of a known resistance, preferably about an ohm, you can proceed to construct from it a delicate ohm which will be in error by only a very small amount. Get 10 or a dozen little wooden spools, either turning them out or taking such as thread is wound upon; prepare these spools by cutting little slips of your sheet copper—which should be about the thickness of thin cardboard—a quarter of an inch wide and one and a half inches long; fasten one of these on to each flange of the spool by means of your little screws, bringing it quite firmly into place, with both slips of the same length and in the same direction, projecting about an inch beyond the edge of the flange. Now measure off by means of the metre stick on your bridge exactly a metre of your German silver wire and measure its resistance. From this calculate the exact length which will be required for an ohm's resistance, cut off this length, plus about an inch for making connections, drive a little peg into the side of your spool, double the wire and wind the resistance coil exactly as you did the first one which you made. Solder one of the ends firmly to one of the copper strips upon the spool, punch a minute hole through the other strip, pull the end of the wire through an inch less the distance taken up by soldering at the other end and fasten it temporarily with a drop of solder. Then, after allowing a few minutes for the coil to cool, measure the resistance, and if it is too great, or too small, melt off the drop of solder and slip the wire backward and forward a minute distance, as the case may require, and try it again. Two or three trials will generally enable you to hit a point at which the balance is quite exact.

Now construct—following precisely the same method—another ohm coil, then connect the two in series by clamping the ends of the copper strips firmly together and temporarily soldering them, and using this pair as a standard resistance construct two two-ohm coils and with these and one of the ohm coils construct a five-ohm coil. After completing these they should be given a thorough coating of shellac. With these coils you can readily measure all the combinations of resistances up to 10 ohms, and by putting the two one-ohm coils in parallel you can get half an ohm.

It will be a good exercise for you to try these coils against the copper ones you originally made, and see how they compare.

Your next addition to your list of resistances may be a 10-ohm coil, constructed by comparison with the five-ohm the two two-ohm and one of the one-ohm coils. Two 20-ohm coils in addition to these will give you the means of measuring directly up to about 60 ohms, and if you can construct a single 50-ohm coil you will have a rather efficient set for all ordinary purposes.

These resistance coils can be readily used separately by soldering to each of the copper strips a piece of copper wire, about No. 14, long enough to allow the coil to be put in one of the gaps of the slide-metre bridge. For many purposes, however, it is more convenient to have them made up into a regular box, so that the connections can be readily made. I will reserve the description of the details of this arrangement for the present.

A Cable to the Bahamas.

One of the small but very useful electrical enterprises that have just been carried into operation is the completion of a submarine cable to the Bahamas between Nassau and Jupiter Inlet, Fla. A few days ago the first message was sent from New York to Nassau, and now the Bahamas are fairly within direct telegraphic reach of the United States. The length of the new cable is about 220 miles, and it connects directly with the Western Union Telegraph system at Jacksonville. Gradually the telegraphic network is spreading under the ocean from island to island and continent to continent, until before many years it will be possible to send a message clear around the world. A Pacific cable is already one of the probabilities, and the completion of it would be the final link that would complete the electrical belt around our planet. Truly the seed sown by Cyrus W. Field and his enterprising friends more than thirty years ago has borne fruit beyond all expectation. The laying of the first Atlantic cable was the great demonstration of submarine telegraphy for which the world was waiting.

The Electrical Features of the City of Buffalo.

BY CARL HERING.

WHEN an electrician visits any other city than the one in which he lives he has a natural desire to inspect its various electrical features and to observe with a critical eye and with some degree of care the methods pursued by the managers of the prominent lighting and power plants in the conduct of a business similar to his own. He is also usually sufficiently interested to make a critical examination of the different types of machinery used and of the constructional details of each individual plant. In order that those who visit the city of Buffalo this month to attend the meeting of the National Electric Light Association may be prepared to profit by an inspection of the electrical features of the city we propose to give herewith a brief description of the electric lighting and electric railway plants of the Convention city, pointing out the special features of the various installations.

The history of electric lighting in the city of Buffalo dates from March, 1880, as will be seen by the following extract from the Buffalo *Sunday News* of March 7th, 1880: "During this week the front of the *Sunday News* building will be illuminated with a powerful electric light—the first ever used in this city. The exterior of the building will of course present a fine sight, and those who want to see the brightest and most marvelous invention of the current decade will no longer be compelled to go out of town to do so. As soon as the wires can be laid and the powerful generators and other intricate attachments put in working order the entire interior of the building, as well as the press rooms and composing room will be lighted with the new device, which changes a night black as Hades into a glorious sunny day."

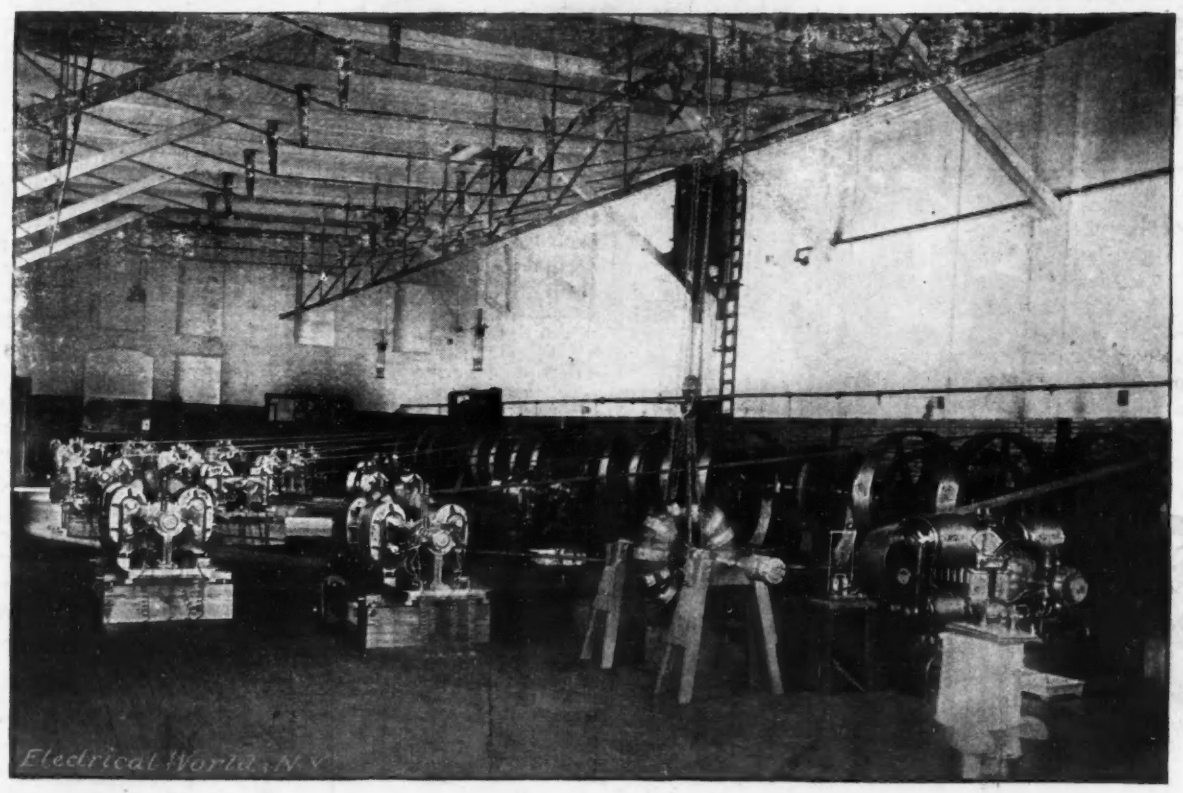
The installation mentioned in this extract was made at the time mentioned, as will be seen by the following quotation taken from the Buffalo *Courier* of March 10, 1880:

"Last evening the street front of the *Sunday News* building was brilliantly illuminated with the Edison electric light, and the working of the new invention was successful. Thus far but one light has been placed and that is projected from the window in the third story. The light is of 10,000 c. p., and last evening was worked at about 7,000. The effect was a beautiful one, and during the evening a vast number of people were attracted to the vicinity to watch the brilliant spectacle. . . . The arrangements thus far are quite experimental and many improvements will be made. Five lights in all will be disposed as follows: One for street illumination, one in the business office, one in the editorial department, one in the composing room and the other in the press room. This is the first electric light introduced in this city, and Mr. E. H. Butler is entitled to credit for appropriating new and useful improvements in his rapidly increasing business."

From this small beginning the industry has grown until at the present time the electric lighting of the city of Buffalo is distributed among four central stations, which, through the wisdom of their respective management, work in profitable harmony instead of unprofitable competition with each other. Each station has its own section of the city best suited to its location and limits its lighting to its own territory. The largest of these is one of the two Brush stations, which, owing to the able and well directed management of Mr. C. R. Huntley, the President of the National Electric Light Association, is a very successful and profitable arc light station. This company, appreciating the advantages of condensing engines, has located its station near a small river in the south end of the city, where water can be obtained for the slight cost of pumping it. Notwithstanding that this location is by no means central to the district lighted by it, the advantages of the condensing engines are apparently greater than the disadvantages of having long lines. This station is now being greatly enlarged and rearranged, much trouble having been experienced with the foundation of their present engine. They are just now adding a new large 1,500-h. p. engine in addition to the present 1,000-h. p. engine. Owing to the nature of the ground the new foundations are built on solid crib work, over which is placed a large layer of concrete.

The station is for arc lights only, and is run only at night. The present capacity is 1,020 lights, which are run for a total of 4,208 hours a year. The price they receive for city lighting is $40 a light per year for all-night lights and $30 a year for private lights running half the night. An interesting feature is that, owing to the able management, the coal consumption has been reduced to 1.93 pounds per light per hour, which, as it includes all the many losses between the coal pile and the light itself, appears to be a very good figure. All the circuits are run with No. 6 wires, and many of them are quite long, one of them being 21 miles. One of the main features in the eyes of the management has been to pay the greatest dividends consistent with good management, and it will be noticed by any one visiting the station that there is a noticeable absence of polished brass work and machinery, elaborate and highly polished switchboards, etc., all of which do not aid in the least in the successful running of the station, but on the contrary, require extensive labor to keep them in proper condition for the sole purpose of pleasing the eye of visitors to the station. A noticeable feature is that the large engine is painted all over, there being not a single polished portion other than the bearing surfaces. Mr. Huntley wisely remarked that the polished work pays no dividends, but on the contrary, diminishes them. Great attention was paid to the handling of the coal from the cars to the boiler, and it has now been reduced, by properly laying out the station, to the small figure of 3 cents per ton. The price which they pay for coal is $3 per ton, the cost of handling it being therefore only one per cent. The boilers used are made by the National Water Tube Boiler Company. They also use an upright boiler, for which they claim the great advantage that the steam is very dry.

In their two stations they have gone to the extremes in the units of their steam engine. In their old station in the city each dynamo has its own engine with which it is directly belted, while in this station there is at present only a single 1,000-h. p. engine driving a line of shafting. It appears that their experience has led them to preferring large engines, but to have at least two of them with a driving gear permitting the use of one or the other, or both. The engine which is used at present is a tandem cylinder condensing engine of the Reynolds-Corliss type. The new one, which is at present being erected, and which is shown in the accompanying illustration, is 1,500 h. p., having two separate cylinders. Some idea of the size of it may be obtained from the dimensions of the fly-wheel, which is 28 feet in diameter and has a 76-inch face. The belt, made by Messrs. Bickford & Francis, of Buffalo, is 129¼ feet long, weighing 1,700 pounds. To make it the hides of 150 cattle were required, as only the best part of each hide could be used. The condensing cylinder is 64 inches in diameter, the speed is 65 revolutions, and the boiler pressure, 130 pounds. The cylinders are so arranged that in case of emergency either one may be used alone, or both may be used together at high pressure. The foundation is arranged on piers as distinguished from having a wheel-pit for this large fly-wheel, thereby facilitating the accessibility and affording additional room for steam piping and other accessory apparatus. In addition to these two engines they will have a small high speed engine sufficient to run one or two dynamos for early lighting or for all day work.



INTERIOR VIEW OF THE BRUSH ELECTRIC LIGHTING STATION AT BUFFALO.

In the steam fitting they used 14-inch lap welded pipe. It is claimed that one length can be handled by two men. They use a Westinghouse separator and loop for returning the water to the boiler.

The driving gear consists of one main line of shafting and one large countershaft, part of which is shown in the adjoining illustration. Each dynamo is driven by means of a Hill friction clutch; the engines also are connected to the shaft by means of friction clutches, and in one case by the aid of a hollow shaft, making a very complete and flexible system by means of which any one of the dynamos or engines may be thrown in or out of gear. Their experience with these friction clutches has evidently been a good one, as they are introducing them in the new portion of the plant, which in one case required a friction clutch for 1,500 h. p. The only objection that they have experienced to these clutches is that the oil from their bearing finds its way to the pulley and thence to the belt, making them all very oily. An additional feature in their driving gear is that they wind the surface of their dynamo pulleys with rope or cord which is afterward painted with a thick Brazilian gum, making a hard layer on the surface. This appears to have been very successful, and they are introducing it throughout; they claim that a pulley so covered is equivalent to a paper pulley without the disadvantages of going to pieces, which they have experienced with paper pulleys. It is an improvement which can be added at small expense to any existing plant, without removing the pulleys.

At present they are using 18 Brush dynamos of 60 lights each, one 12-coil Weston electric dynamo, and one 100 light Wood dynamo of 5,000 volts. Although they are very well satisfied with the Brush machines, they claim that the unit is too small and they are now about to add twelve 100-light Wood machines. The confidence they have in their machines is shown by the fact that they keep only one reserve dynamo. There is besides this a spare Brush armature, which is kept hanging on the crane ready to be inserted at a moment's notice into any one of the machines. It is stated that an armature in one of their Brush machines can in this way be changed in seven minutes, which certainly is very quick work. The oil is fed by gravity to all the dynamos by means of a system of piping and a large tank. It is collected from these dynamos by a system of piping under the floor which leads to a common tank, from which it is pumped up, cleaned and led back into the supply tank.

The switchboard is the ideal of simplicity in its construction. It includes a Thomson-Houston lightning arrester and a crude indicator, for each line circuit. All the lines and the dynamo terminals lead to the switchboard and terminate there in the usual spring clamps which are connected to each other by means of short flexible wires, terminating in the usual nipple plug with wooden handles, thus enabling any one or more circuits to be connected to any dynamo. In this respect it differs from other switchboards in which the lines terminate in flexible plug terminals, which has the disadvantage of requiring these terminals to be found among the usual net work of loose wires in front of such a switchboard. The dynamo connections run under the floor, leaving all the space above the dynamos free from wires, which would necessarily interfere very greatly in case of any alterations or repairs to the dynamos. The whole station is run with only five men, there being two firemen, one engineer, one oiler and one dynamo attendant, who also has charge of the circuits. Besides these there are, of course, the linemen, who are on outside duty. An interesting addition has lately been made to the plant in the form of a line of piping containing compressed air and terminating in flexible hose with nozzles. The object of these is two-fold, to blow out any arcs which may form accidentally and to clean the dynamos; for the latter especially, it is a very useful addition. The compressed air is obtained from a Westinghouse air brake pump such as is used on locomotives.

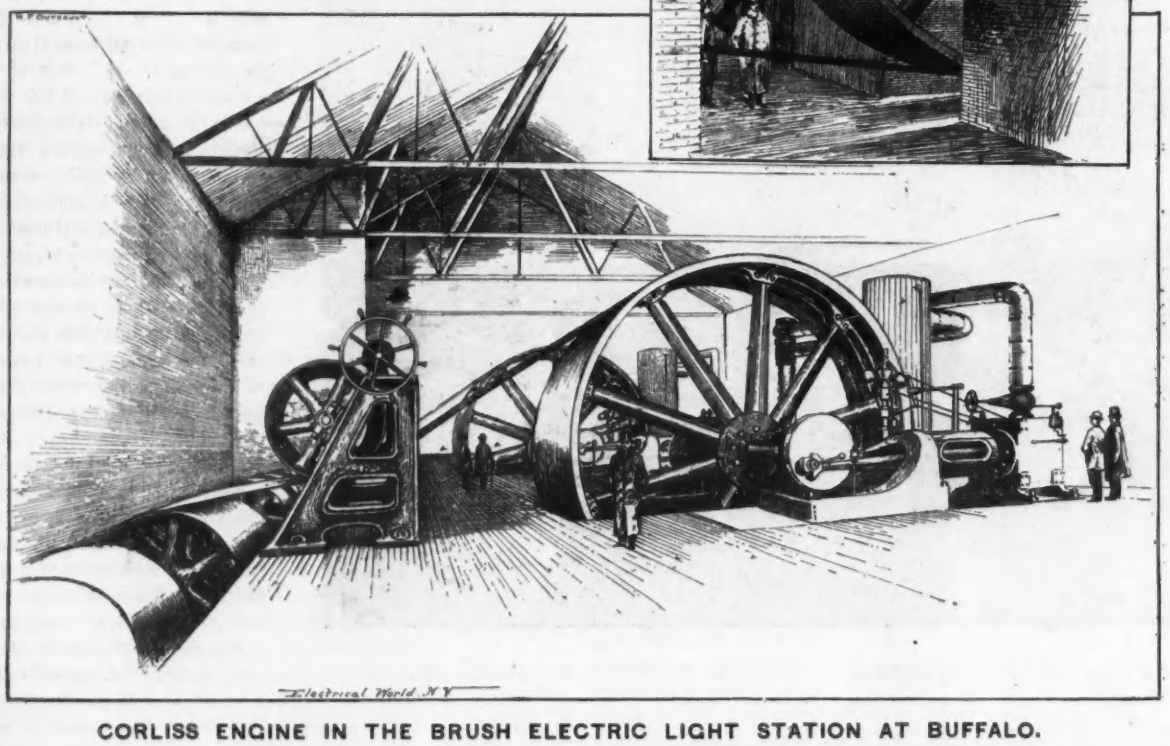
The other Brush station in this city is a small one, situated in the heart of the city. It was built in 1882 and is among the first in the United States. It is not a model station, and the manager takes no pride in it. Notwithstanding the unfavorable arrangements, it runs day and night, leaving no chance for making repairs in the steam piping, which are so badly needed. The steam engine units in this station are very small, each dynamo being driven by its own high speed Westinghouse engine. It contains a few Brush machines and a 1,000-volt alternating current machine for incandescent lighting. Whenever the supply permits, they use as fuel natural gas, which is brought from a distance of 108 miles. They state it to be the ideal fuel and consider it far preferable in many respects to coal; it gives a clean, hot fire and requires very little attention.

The Thomson-Houston station is located in the centre of the city. Owing to this fact, the whole station is in a very cramped position. Although its capacity is nearly equal to that of the Brush, the station itself is very much

smaller. Their present capacity is 480 city arc lights, 190 commercial arc lights, 3,500 incandescent lights from a 1,000-volt alternating current system, and a small number of lights in the immediate neighborhood from a direct current system. In addition to this, they are at present starting a 500-volt power circuit with a 65-h. p. Thomson-Houston machine. They sell their incandescent lights by meter or by monthly rates, the smallest meter being a ten-light meter. They sell their power according to measurements made with ampère and voltmeter at the motor.

The boilers used are horizontal tubular, with a Brightman automatic stoker, which they say is very satisfactory. They have in addition two 180-h. p. upright boilers, which they say are very economical in space and fuel, but are not as readily cleaned and repaired. The engines used are Rice automatic high pressure engines, aggregating 1,100 h. p. They use a cold air blast of 5 pounds pressure under the dynamos, the escape being directed to the armature. In addition to this they are about introducing a 10-pound air blast with hose connections for cleaning the dynamos. In addition to the repair shop there is a crane and track connecting it with the dynamo armature, by means of which they state they can change an armature in the spherical armature machine in 40 minutes, which is quick work. The dynamos are mostly of the usual Thomson-Houston spherical type, including also three Western electric machines. The alternating current machine is of the Thomson-Houston compound separately excited type.

One of the interesting features of this station is, that they use their exhaust steam for heating private buildings in the vicinity of the station. The process formerly used was to discharge the steam directly into the heating pipes, which, however, necessarily caused a back pressure. They are replacing this system now by the Bernard vacuum system, in which there is a condenser at the return end. The advantage of this is that there is no back pressure and that they get the benefit of the hot water from the return pipes, which, however, is limited to that from the buildings which are higher than the station, as the water returns by gravity; in low buildings the water is discharged. The disadvantage of the vacuum system is that it requires a return system or piping. Their charges are 25 to 30 cents per year per square foot of radiating surface of the heater. They are very well satisfied with the system and find it an excellent investment. They limit the amount to that which they can supply with the exhaust steam only, which at present is never less than 200 h. p.



CORLISS ENGINE IN THE BRUSH ELECTRIC LIGHT STATION AT BUFFALO.

As in Boston, the railways in Buffalo are operated partly by electricity and partly by horses. The electric lines were started in July of last year, and they are contemplating the equipment of their whole line electrically. Having started so recently, they are not yet fully prepared to operate the system under the best conditions, but, notwithstanding this, their return shows a cost of 11 cents per car mile for the electrical cars as against 19 cents for the horse cars. This plan is especially interesting, because all the feeders are underground, in which feature we believe it stands alone among all the large railway plants.

The boilers are of the Babcock & Wilcox type of 250 h. p. units, with Roney automatic stokers, and carrying 120 lbs. pressure. They are equipped with a duplicate system of piping, one in front and one in the rear of the boilers. All the piping in the dynamo room is located beneath the floor and between the piers forming the foundation of the dynamos, the great advantage of which is that it is very easily accessible for examination and repairs. The whole set of piping is supported on rollers. In connection with the boiler plant there is a chimney 150 ft. high, with a flue 7 × 7 ft.

The engines are mostly of the Ball condensing type of 250-h. p. each, belted directly, one to each dynamo. There is also a 500-h. p. upright engine of the Lake Erie Engineering Works, which they claim is giving great satisfaction, so much so that they are about arranging for another one. The variation of speed of these engines is stated to be only from 1 to 1¼ per cent. between no load and full load. This is certainly a very good figure, and a very important factor for railway work, in which the power varies very suddenly and between such very wide limits.

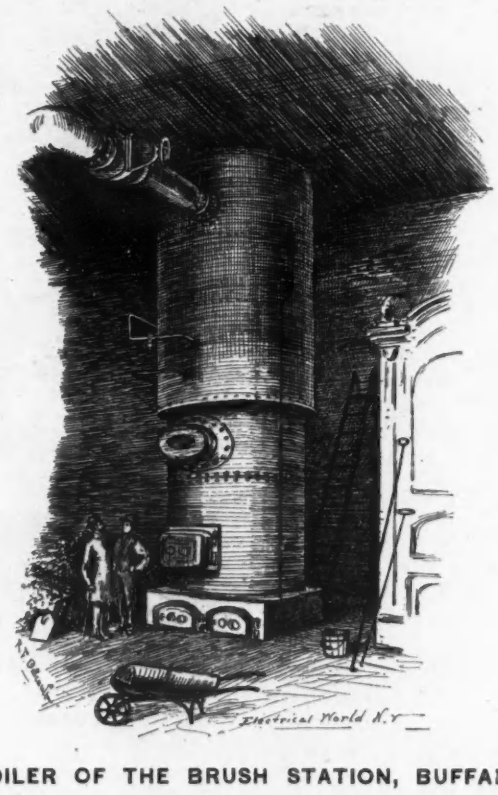
The dynamos are all of the Edison bipolar type. They are compound wound, the series winding being equalized by loops of cables inserted in the circuit.

The switchboard is located on a platform from which the whole dynamo room can be seen. Each feeder and each dynamo is provided with fuses that are very readily replaced, as they state in some cases the fuses are blown as fast as they can replace them. There is an ampèremeter in each dynamo circuit, by means of which the dynamos, which work in multiple arc, can be equalized, also an ampèremeter in each feeder circuit, as well as one in the bus wire circuit. Although they run all the dynamos in multiple, provision is also made for running a 600-volt circuit for the long feeders, the switches for the dynamos being so arranged that any one or more of the circuits may be connected with this second system of 600 volts, which they call the supplementary system. On double track lines they run two independent systems, one for each track, so arranged at the poles that if one side fails it can be connected to the other side. The lightning arresters used are of the Thomson-Houston and the Westinghouse types; they state that they have had very little trouble with lightning so far, but what they have had has been well taken care of by the arresters. Having an underground system of feeders they require a lightning arrester wherever the feeders are joined to the overhead lines.

A very interesting feature of this system is that all the feeders are underground, the total length being at present 75 miles. All the feeders are of the same cross-section, being a 0000 stranded cable of the Habirshaw and the Standard Underground Company's make. They are lead covered and are protected on the outside with a painted cotton covering. The longest single line is 7½ miles. The lines are laid in pipes or ducts, some of which are those of the National Tube Company and others of the Indurated Fibre Company. They are run three in a duct, but although the wires in a duct are all of about the same potential, the difficulties are greatly increased by the fact that one pole of the circuit is always grounded. Notwithstanding this, however, they are very well satisfied with these underground wires, and up to date have had only one mishap. This was due to a collection of gas in one of the manholes, which was ignited by a candle used by one of the workmen, the flame traveling through the duct to another manhole and burning out the cable in that duct. Another slight disadvantage in the underground work is that the cables cannot be forced like the overhead wires, because the radiation of heat is much less than it would be on the overhead lines, where a wire can be forced to a very great extent. The total loss on the circuit is 20 per cent., including the feeders and ground returns. The negative pole is the one which is grounded; great attention is paid to grounding wherever it is possible; connections to gas and water pipes are made wherever there is an opportunity; ground plates are laid in the water wherever its proximity will admit. From the dynamos the negative poles are led by cables to the rails and to a number of places in the neighborhood where good ground can be obtained.

Great attention is paid to the connections at the junction boxes, for as is well known, one of the weak points in lead covered cables is the terminal where the lead is stripped off in order to make a connection with the copper. The junction boxes are so arranged that the cables enter through holes fitting them quite closely, into which the lead coating is soldered like in a plumber's joint, making it completely water tight. These junction boxes are located at convenient places for connecting them to the overhead lines, as also for testing, making and changing connections, etc. Great attention is paid to testing the lines. This is done at the station by means of a resistance galvanometer and the usual testing set. Although a pier was built to support the galvanometer, it was found impossible to keep the needle from trembling, but it was finally overcome by placing the galvanometer on a heavy slab of marble, which was suspended by four strong springs. The whole galvanometer is furthermore inclosed in a short section of a massive iron pipe so as to protect it from the magnetic influence of the dynamos and currents. When the station was started in July, the lines tested 140 megohms; since then they have increased and now test 225 megohms. In connection with the testing apparatus, there is a telephone circuit which is connected by underground wires to all the junction boxes, so that the operator is in constant connection with an attendant at any junction box. The attendant carries his own telephone, and connects it by a simple contrivance to a small junction box in the telephone circuit. The testing is mostly conducted at night.

At present they have 45 miles of track and are running 65 cars in all; 30 of them are long cars, 35 feet in length, and the rest are the usual small cars. The cars are equipped with Thomson-Houston single reduction motors; the gearing being run in a mixture of plumbago and grease. Most of the accessories are those of the Thomson-Houston Company; the plant itself, however, was constructed by the Field Engineering Company. Up to the present time they have not been able to use their condensing engines as such, on account of the want of water, although they are within 100 feet of the river. They are, however, at present building their condensing plant, after which they hope to have a better power efficiency. Notwithstanding that they are running under these difficulties, their last reports show a cost of operating of 11 cents per car mile for the electrical lines, and 19 cents for the horse lines. The former figure will doubtless be considerably reduced when their plant is completed.



BOILER OF THE BRUSH STATION, BUFFALO.

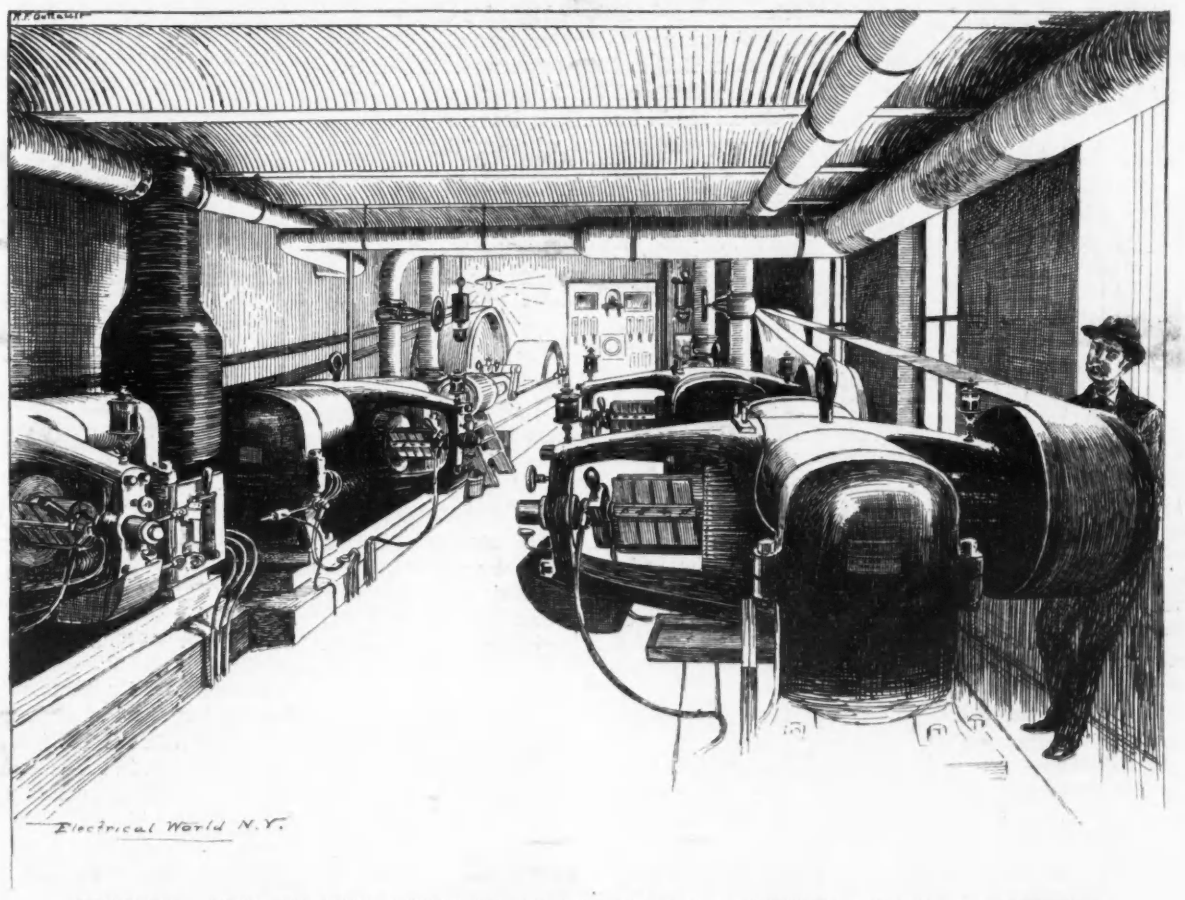
Probably the largest private plant in Buffalo is that at the Hotel Iroquois, the largest hotel in Buffalo, and, being the hotel in which the Convention will have its headquarters, a short description of it here may be of interest to those who are about to visit the Convention.

A good view of the dynamo room is shown in the accompanying illustration. The plant consists of four United States incandescent light machines driven by two Rice automatic engines of about 120 h. p. each, making 260 revolutions. It will be noticed that the dynamo room is rather cramped, but, notwithstanding this, the disposition of the machinery is a very favorable one, both in the economy of space and in the accessibility. It will be noticed that the two belts from the single fly wheel of the engine are run next to each other instead of over each other; this arrangement the engineer claims is preferable to running two belts over each other because the inside belt in the latter case is strained too much. The belting used is what is called the cotton leather belt, which consists mainly of a cotton belt having glued on its inner surface a thin lining of leather. It is said by the engineer to give very good satisfaction. Great attention is paid apparently to the steadiness in the lights. It was found from a test

that the variation of the speed of the engine from no load to full load was three revolutions.

The four dynamos, of 650 lights each, are of the well known United States type, and need no further description here. They are compound wound, and, as they are all connected in multiple arc, compensating or equalizing wires are introduced, so that the load will not be unequally divided among the machines. The series winding connections are led to a common point under the floor situated equally distant from all the dynamos, in order that the resistance of the series windings may be as nearly equal as possible; from this common point the main bus wire leads to the switchboard, the other poles of the dynamos being connected by separate ampère meters on which the distribution of the load can be seen. Besides these equalizing bars, there is a simple rheostat in the series circuit at each machine, which is shown in the illustration. It consists merely of a short bar of copper inserted in the circuit and having a sliding T-connection which can be moved along the bar, so as to regulate for slight variations in the resistance of the series coils. It is stated that the temperature of the room, and the different temperatures of the various dynamos are sufficient to make an error in the equalization of the loads, and that these rheostats have to be moved to compensate for such differences. When the dynamos were first put up, there was a switch on the dynamo, as well as one on the switchboard, both of which had to be operated when the dynamo was thrown into or out of circuit. The present arrangement does away with this inconvenience, and there is now only one double switch at each dynamo, as will be seen in the illustration, by the operation of which single switch both connections are simultaneously made.

The switchboard seen in the rear consists mainly of individual single pole switches, one for each circuit in the building. There are furthermore four ampère meters, one in the circuit of each dynamo, by means of which the load may be equalized, and one common voltmeter connected to the bus wires. The voltage of the bus wire is regulated by the common rheostat in circuit with all the four shunt windings. Besides this, there are four individual rheostats, one for each shunt winding, by means of which the potential of each machine separately can be regulated so as to distribute the load equally. The total capacity is about 2,500 lights, of which 350 are located in the library building, 600 feet distant, where the meetings of the Convention will take place. The wiring throughout the hotel is mostly okonite wire laid in the plaster. The only trouble which they have experienced was under the tiling, where it appears that the moisture did not dry out. All wires under the tiling were therefore relaid in hard rubber tubing, after which no further trouble was experienced. In the wiring of the building the maximum number of lamps on the circuit is eight.



GENERAL VIEW OF THE LIGHTING PLANT IN THE IROQUOIS HOTEL AT BUFFALO.

There are also two motors, of 5 and 18 h. p., one for a ventilating fan in the engine room, and the other in the kitchen for running a dish washer, ice-cream freezer, ventilating fans, etc. In the laundry they are using a steam engine, but the engineer states that it would have been much better in many ways if a motor had been placed there instead of the steam engine. The difference in the attention required, the economy of space and the absence of dirt and oil which generally accompany a steam engine, are all very much in favor of using the motor instead, and it is not likely that in a new plant of this sort anything but an electric motor would be considered.

The steam plant is quite complete, and, as it is used for many other purposes than the electric lighting, it is quite large in proportion to the electric lighting plant. The fuel used is natural gas, the advantages of which are so evident that they need hardly be mentioned here. This fuel seems to be quite largely used in Buffalo, and it appears to be considered, wherever it is used, to be the ideal fuel. The difference in the appearance of a boiler room using gas from one using coal is noticeable at once, from its neat and cleanly appearance, economy in space, and the absence of all coal and ashes, together with the dust and dirt accompanying the same.

Great trouble was at first experienced in this plant from the amount of sediment and scale produced in the boilers from the water used. The tubes of the boilers had to be cleaned every six weeks. They have lately introduced an addition which is claimed to have proved so satisfactory that it will doubtless be of interest here to any one interested in electric lighting installations. All the condensation water from the various sources where steam is used is collected in a trap, from which it is pumped into a feed water heater known as "The Buffalo Feed Water Heater and Purifier." In this it passes over a series of shelves in a closed chamber, dropping from one to the other, and collecting at the bottom. Live steam is admitted under boiler pressure to the upper portion, which heats the water to nearly the temperature of the boiler, that is, to 280 or 290 degrees. This causes all the solid matter to deposit in this apparatus, from which most of it is readily removed by frequently blowing out this heater, which is done every two or three hours. It is quite interesting to see the large amount of deposits which collect in this purifier, and which, were it not for this apparatus, would deposit in the boiler. It is claimed also that if the feed water is heated to boiler temperature before entering, it is much better for the boiler, as there is then not the same liability to unequal expansions and contractions, which are so detrimental to the joints of the tubes. It is stated that since this apparatus was used, they have had no trouble with the leaks at the tube joints in the boiler. Although the tubes were formerly cleaned every six weeks, it is now over five months since this apparatus was used and they have not yet required any cleaning. The water from all sources was first collected and passed through an Otis heater and from there into the purifier just described. The steam used in the kitchen for cooking purposes is all under boiler pressure, but the heating of the building is accomplished with exhaust at from one-half to five pounds pressure.

The whole steam plant is in every respect a very complete one, including among other things a De la Vergne ammonia ice machine, having a capacity of 12 tons a day, by means of which all the refrigerating in the building is performed. In this system a brine is cooled by the ice machine to a temperature of about 10 degrees; this is then pumped through a system of pipes leading to the various rooms in which the refrigerators are located. In the refrigerators this circulates through a coil of pipes similar to those used in steam heating, on the outside of which the moisture of the air forms an almost solid wall of dry ice. In the cellar this brine is circulated through tanks in which ice is made either in blocks or in the carafes. The system admits of nice regulation; in the bar room, for instance, there are three refrigerators at different temperatures, one below the freezing point for champagne, one just above for mineral waters, and another at about the temperature of spring water for beers.

One of the most recent private plants in Buffalo is that in the Hotel Broezel, installed by Messrs. F. P. Little & Co., of Buffalo: It consists of two 75-h. p. National Water Tube Company's boilers, one 30-h. p. and one 50-h. p. Rice automatic high speed engine, driving a 300-light and a 500-light Thomson-Houston incandescent machine, with spherical armature, compound wound as usual. The two machines are run in multiple, with the usual equalizing apparatus for the compound winding. The switchboard contains the usual indicating and measuring apparatus, together with a simple ground detector arranged so that by pressing a knob, if there is any ground, one or the other of two lamps will indicate it, and show which pole it is on.

The steam plant includes the usual separator and feed water heater, including also an oil separator, in which the oil is extracted from the steam before the latter is returned to the boiler. Appreciating the advantages of electric motors over individual steam engines, they are about to introduce these motors in connection with their plant for running the machinery in the kitchen, the laundry, etc., in which it will replace a small steam engine which is used there at present.

Notes on Electromagnetic Machinery.—I.*

BY WM. S. ALDRICH, M. E.

The terms machinery, machines, mechanisms are scarcely synonymous, though often so used. Early writers on the subject, among which the names of Monge, Carnot and Lanz are prominent, speak of mechanisms as means for altering or changing the direction of motion; such as the conversion of motion from continuous circular to reciprocating rectilinear motion. Ampère defined those mechanisms to be pure which consisted entirely of rigid bodies, limiting, as it were, the definition to the means by which the motion was produced or transferred; and he defines a machine to be "an instrument by the help of which the direction and velocity of a given motion can be altered." Willis, in his "Principles of Mechanism," follows closely, at first, with a classification based on comparative motion, subordinating the means and modes of communication by which these motions were obtained; but later making the mode of communication primary and the comparative motion secondary in his classification of the elementary combinations of pure mechanism. Rankine, in his "Machinery and Millwork," adheres to Willis' later classification, but includes hydraulic connection as having a legitimate place among the means for the communication of motion in mechanisms. This marks a definite advance, for the means employed to communicate or transmit motion may be quite different, but the kinematic question remains the same—which is that of pure motion.

The idea of the kinematic chain was brought out by Reuleaux, in his work on the "Kinematics of Machinery," as the next step in the development of the science of machinery. He thus defines a mechanism to be "a closed kinematic chain, which is compound or simple, and consists of pairs of elements; these carry the envelopes for the motion which the parts in contact must be given, and by these envelopes all other motions are prevented." The constrainment of motion now becomes a fundamental condition for every mechanism, and subordinates the mere question of directional relation or of velocity ratio, as determined by the comparative motion of any two points of the mechanism. A machine is a mechanism so operated as to do work, and is stated by Reuleaux to be "a combination of resistant bodies so arranged that by their means the mechanical forces of nature can be compelled to do work, accompanied by certain, definite motions."

The electromagnetic connection of moving parts, in a mechanism or a machine, followed naturally upon the inclusion of hydraulic and pneumatic modes of communicating motion. For development in any line becomes apparent when a general identity is to be seen through many special varieties. And, however varied may be the mechanical movements of any machinery, or however simple the relative motions amidst the complicated mechanism, the ultimate analysis shows simple well-known motions, obtained by well-known pairs of elements and kinematic chains, whether such chains are composed entirely of rigid connecting elements, or of hydraulic, pneumatic, or electromagnetic connection. Seeing, therefore, that the time was ripe for another mode of connection in mechanism, and should include the electromagnetic forces of nature as among "the mechanical forces of nature [that] can be compelled to do work, accompanied by certain definite motions," Silvanus P. Thompson has given us the term "electromagnetic mechanisms," and considered them somewhat at length in connection with his work on "The Electromagnet." It is my purpose in these papers to speak of these mechanisms when put to do work as electromagnetic machines; and the general term, electromagnetic machinery, will include such mechanisms as may be more or less useful in the conversion of motion under constrainment, and such machines as may be useful in the direct transmission of energy—by electromagnetic means.

The medium for the transmission of energy may likewise serve, as it often does, as the means for communicating motion; and when energy is transmitted along with the conversion or transfer of motion in any mechanism, that mechanism becomes a machine. Any medium, there-

* A paper read before the Electrical Section of the Franklin Institute.

fore, which is of such a nature as to admit of its being made a part or link in the mechanism of the energy cycle, will serve in almost all cases equally well for the transmission of energy or of motion; provided, that notwithstanding the deformations to which it may be subjected the medium is capable of returning to its original condition. Some mediums or links are practically incompressible and inextensible, within the usual limits of the transmitted energy; such as iron rods retaining their form throughout, and a water connection, which retains its volume while altering its volume form. Other mediums admit of practical extension, but are of little use in compression; such as belts, wire ropes, and like flectional elements used as wrapping connectors in mechanism. Compressed air, springs, and like flectional elements admit of practical extension and compression, and are of more or less value in the transmission of energy; but of little use

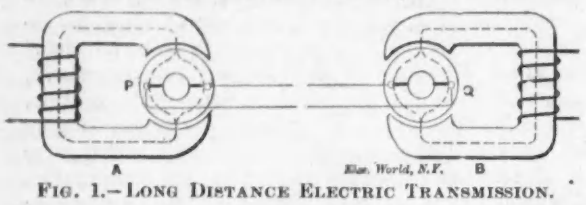


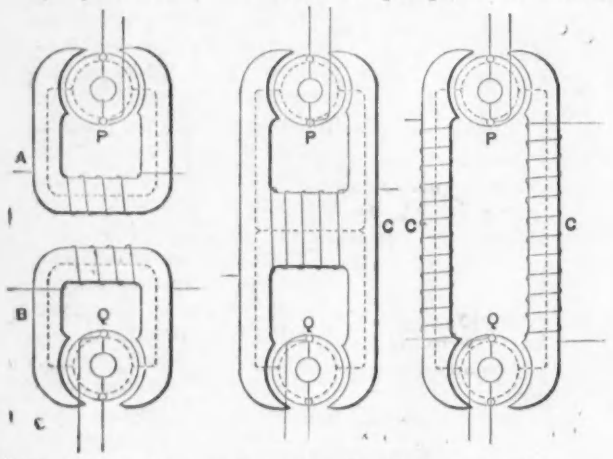
Fig. 1.—Long Distance Electric Transmission.

as elements or links of a kinematic chain, for constrained motion. In all of these energy is transferred by and through matter in some one of its many forms—matter which follows the laws of continuity of matter and of space, while entering as a medium in the continuity of energy.

Systems for the transmission of energy have therefore become quite definitely established, for long or short distances, and have taken the following broad lines of development:

(1) Mechanical transmission by belts, wire ropes and other wrapping connectors for long or short distances, and by gear wheels, links, screws, cams, ratchets and like forms for more immediate and direct transmission.

(2) Hydraulic transmission, with pumps, accumulators,



Figs. 2 to 4.—Short Distance Electric and Electro-Magnetic Transmission.

connections, motors and presses, more or less varied in form for utilizing water pressure.

(3) Pneumatic transmission, with the compressors and apparatus especially adapted to that medium.

(4) Electric transmission, with dynamos, line connections, regulators and motors, and chiefly used in long distance transmission.

It is proposed to add:

(5) Electromagnetic transmission,* in which the dynamo and motor, as generator and receiver, or as driver and follower, shall be in the same magnetic circuit; or in which the magnetic circuit shall be used for direct and immediate distribution of energy for very short distance transmission, in much the same way as the electric circuit is even now used for long distance transmission.

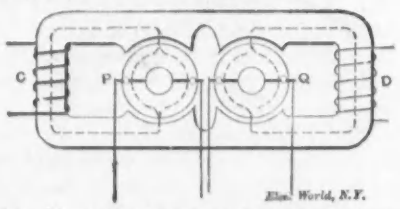


Fig. 5.—Dynamotors for Parallel Shafts.

The ether as the medium for the transfer of energy, by electric or electromagnetic means, has been found to possess many striking analogies to other and better known mediums. By the modern theory of electricity, the electric energy is supposed to be concentrated in the ether surrounding the conductor, or other core of disturbance, and that a transfer of the ether energy takes place whenever electric energy is being transmitted from point to point. However great may be the contrast between the mechanical, hydraulic and pneumatic transmission of energy and the etheric transmission, it remains a fact that energy may be transmitted by all of these means, with varying degrees of efficiency, and accompanied, if desired, by definite conversion of motion. The former three require some material connecting link between driver and follower—some kind of contact of elements, or some pairing of surfaces—while the etheric transmission requires no

* Paper read before the Electric Club of the Johns Hopkins University, Nov. 9, 1881, on "Notes on Electromagnetic Transmission of Energy."

such material contact or pairing; indeed, such contact may kinematically lock the whole mechanism, as an armature, in contact with its core in some special forms of this type of electromagnetic mechanisms. The ether medium allows of the transmission of constant or varying forces, as now transmitted by more material modes of connection, and with the peculiarities of comparative and constrained motion accompanying such energy transmission. By the displacement theory, electricity seems to act as an incompressible fluid. By the researches of Hertz, the ether appears to be possessed of some peculiar mechanical properties, such as inertia and stress and strain manifestations. We have even come to conceive of the mechanism of the ether medium and to picture some of the peculiar manifestations of the ether mechanism as analogous to gear wheel mechanisms.

The kinematic conception of the ether mechanism, in combination with the peculiar mechanical properties apparently possessed by the ether medium, however far from being a true conception may serve the passing moment till a better working hypothesis is presented. We know that the ether energy of the electric current and of the magnetic circuit moves at right angles (normal) to the direction of the current or the axis of the magnet; also,

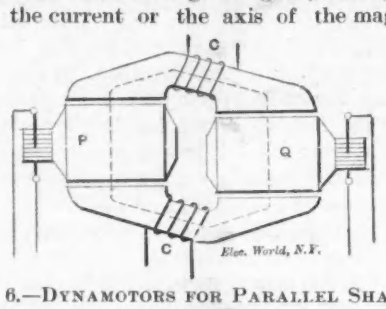
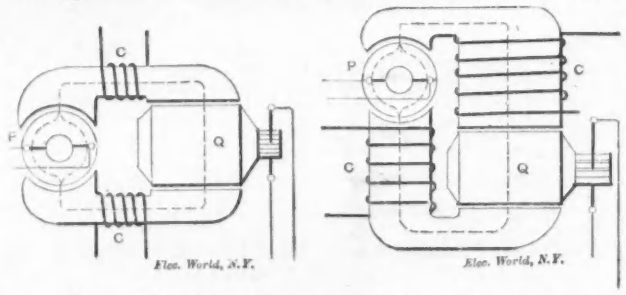


Fig. 6.—Dynamotors for Parallel Shafts.

while the instantaneous direction of motion of a point in the pitch circle of a gear wheel is tangential to its path, the energy is transmitted radially or normal. These peculiar gear wheel properties of the kinematics of the ether mechanism, like all good illustrations, leave us in doubt as to many points; especially as to whether the ether gear wheels are more or less flexibly mounted, as on springs, but with apparently limited or even fixed distances between centres. Perhaps Oliver J. Lodge may yet point out to us whether these gear wheels, as elements in the ether kinematic chain of mechanism (speaking in the phraseology of Reuleaux) are pair-closed, force-closed, or chain-closed. That is, whether they mesh with each other by reason of some peculiarity of their paired connection or characteristic conformation of their toothed outline; or are by some force kept in geared connection, akin, perhaps, to the manifest tendency of the magnetic circuit to complete or perfect itself—to inclose the greatest possible number of lines of force in following the path of least resistance, and yet to remain as undeformed as possible in the presence of opposing magnetic forces—a kind of electromagnetic force-closure; or perhaps these ether gear wheels may have their centres connected by a link or chain device, not yet made clear. And the time may come when the kinematics of this hypothetical mechanism of the ether may be as defi-



Figs. 7 and 8.—Dynamotors for Intersecting and Non Intersecting Axes.

nitely studied as its mechanics, and the paths of its moving elements as clearly laid down as now in the case of link-work, cams, gearing, etc. The ether medium has already been made to yield some of its many possibilities in the applications of electricity and magnetism, and its peculiar characteristics show it to be capable of the widest range of usefulness in the transmission of energy and of motion, for a long or short distance, and by immediate and direct or by indirect means. And the beautiful electromagnetic induction experiments of Elihu Thomson, the high frequency alternating current effects obtained by Tesla, and the researches of Crookes in high vacua, give grounds for hoping that the day is near at hand when these invisible forces will be clearly seen and understood by the things that are made.

Electric transmission of energy is shown in simple ideal form in Fig. 1 for long distances, in Fig. 2 for short distances. In either case, but especially the latter, we may suppose the axes of the two armatures to be placed parallel, or in any given oblique position to each other, being then similar to transmission by belts and wire ropes. The speeds of the two shafts may be maintained constant under changes of load, or varied at will; and the rotations may be in the same or opposite directions, and reversible at will. The current used may be direct or alternating. Power applied to drive one as a dynamo will drive the other as a motor; while if power be applied to both the output will be current in the external circuit, as given by two dynamos coupled for any given output. Current supplied to drive one as a motor will serve to drive the other as a dynamo, giving an electro-motor driven dynamo as a transformer, if the two shafts are in any way coupled or geared; while if current be supplied to both, the output is power from each machine acting as a motor. More than two machines are often used, and sometimes one dynamo operates several motors in the same electric circuit, but with individual magnetic circuits. In the figures from 1 to 12, inclusive, P, Q, R represent armatures and armatured shafts, and A, B, C fields and field coils.

Electro-magnetic transmission of energy is understood to mean that combination for the transmission of energy in which all the armatures are in the same magnetic circuit. (a) One or more of these armatures, as dynamos, may be utilized to generate current, which may be supplied to the

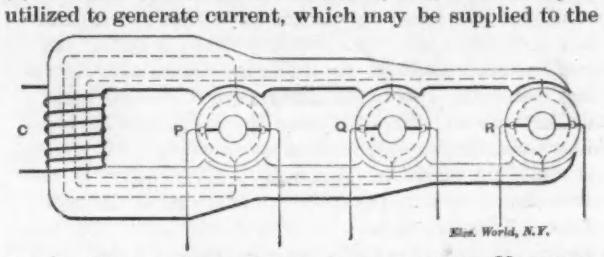


Fig. 9.—Simple Grouping of Armatures in Magnetic Shunt.

remaining armatures, as motors, in the same magnetic circuit; or (b) all the armatures may be run as motors by an external source of supply of current; or (c) all the armatures may be run as dynamos by an external source of power. Figs. 3, 4, 5, 6, 7 and 8 show such combinations of two armatures in the same magnetic circuit, or branches of the same. (a) If armature P is driven by power, as a dynamo, the current supplied to armature Q will drive it as a motor; or (b) if current is supplied to both armatures P and Q, they will run as motors; or (c) if power is applied to both armatures, current will be generated in the external circuit. This last combination is similar to a separate circuit self-exciting dynamo (type of Fig. 4), brought out by Ladd, March 14, 1867, which had two shuttle-wound armatures—a small one to excite the common field magnet and a large one to supply currents for electric lighting. We may also arrange any one of the forms shown (Fig. 2, for instance) as a dynamo transformer, by supplying current to armature P, acting then as a motor, and gearing or otherwise coupling the shafts P and Q, so that armature Q

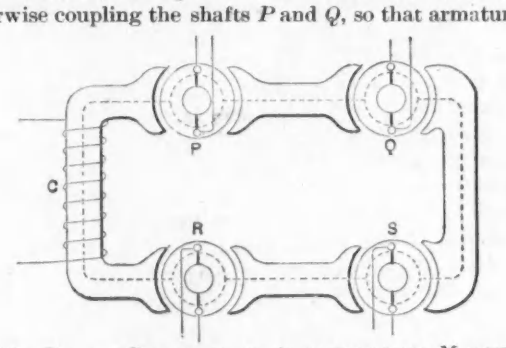
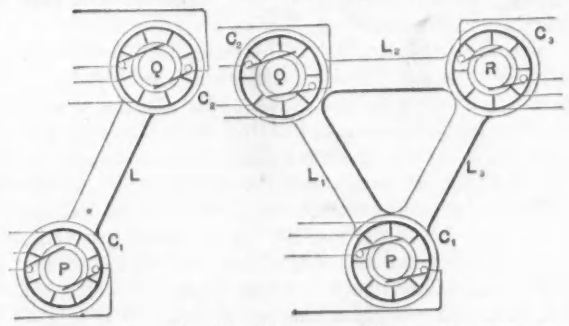


Fig. 10.—Simple Grouping of Armatures in Magnetic Series.

acts as a dynamo, giving a transformed current within any given range.

Dynamotors for electromagnetic transmission of energy are combinations of armatures in the same magnetic circuit, as illustrated in Figs. 3, 4, 5, 6, 7 and 8, which show two armatures in the same magnetic circuit as dynamo and motor. A dynamo-motor combination, in the same electric circuit, but with individual magnetic circuits, as Fig. 2 is really a transformer of mechanical energy; while a motor-dynamo combination, similarly arranged, is a transformer of electrical energy. The dynamotor is also a dynamo-



Figs. 11 and 12.—Elements of Electromagnetic Kinematic Chain.

motor combination, in the same electric and the same magnetic circuits, Figs. 3, 4, 5, 6, 7 and 8, and as such is also a transformer of mechanical energy; but it may also be used as a transformer of electrical energy. These dynamotors allow of a constant or variable velocity ratio being electromagnetically transmitted between two shafts arranged in any way in close proximity, for the immediate and direct transmission of energy. The direction of rotation as well as the velocity ratio may be varied at will. Direct or alternating currents may be used, but preferably the latter, and very probably some form of the so-called rotary current. The dynamotor may be an independent machine, with no external circuit connections, or it may be more or less dependent upon some external source of current supply, either for regulation or velocity ratio, or of its operations as an energy transformer.

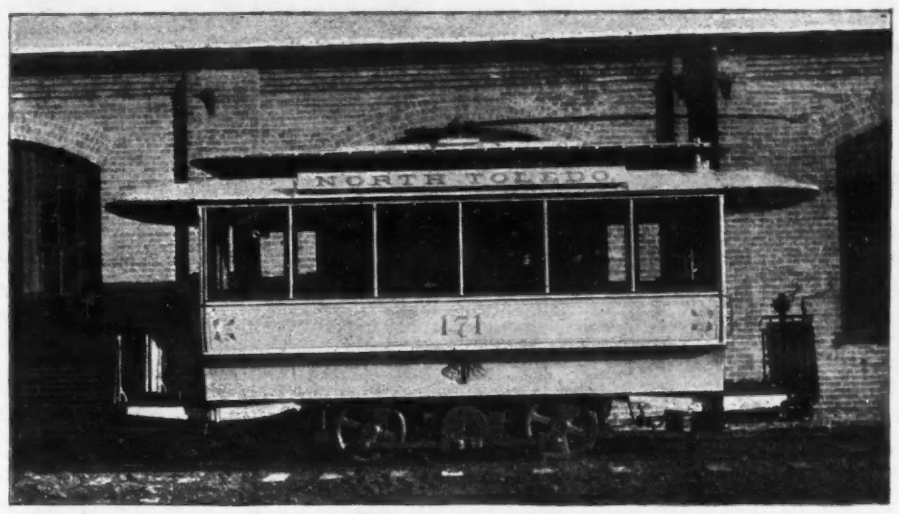
Mechanical equivalents of dynamotors are those mechanical means for the transmission of energy and motion, equivalent, from the standpoint of kinematics, to the elec-

tromagnetic means employed in the dynamotor. Thus, Figs. 3 and 4 show dynamotors for parallel shafts, in ordinary proximity, and have their mechanical equivalents in belts, spur gearing and like means for the transfer of circular motion between parallel shafts. Figs. 5 and 6 show dynamotor forms for parallel shafts very close together, as in Oldham's coupling. Shafts intersecting at an angle, such as in bevel gearing, universal joints, Hooke's joint, etc., are mechanically equivalent to the form of Fig. 7. Screw wheels, worm wheels, and skew-bevel wheels are mechanically equivalent to the form of Fig. 8, for transmission between non-intersecting axes.

Magnetic circuits in parallel and in series admit of a variety of ways of grouping two or more armatures in electromagnetic machinery. Fig. 9 shows the simple ideal grouping in parallel or magnetic shunt, with one energizing coil. The ends of the field at armature *K* may be closed around, and another put in, acting in conjunction with the coil *C*. And with or without this additional coil, separate auxiliary energizing coils, acting in the way of feeders, may be placed between armatures *P* and *Q* and *Q* and *R*. The simple magnetic shunts, to which Sylvanus P. Thompson refers* may develop into useful industrial applications, such as multiple drills, operated by spindles on armatures arranged in parallel magnetic circuit. Other forms of branch magnetic circuits are shown in Figs. 3 and 5. The simple ideal grouping of armatures in series in the magnetic circuit is shown in Fig. 10, with one energizing coil. As before, auxiliary energizing coils may be placed at the other end, or between the armatures *P* and *Q* and *R* and *S*, but these coils do not here act as feeders, as they did before in the parallel arrangement, but rather as separated parts of one large coil controlling the one magnetic circuit. This may be clearly seen by referring to the field coils in Figs. 4, 6, 7 and 8, on page 104, which show the arrangement of two coils in series for one magnetic circuit.

The Dixie Fan Blower.

A combined Dixie blower and electric motor are shown in the accompanying illustration. This blower is manufactured by the Huyett & Smith Manufacturing Company, of Detroit, Mich. As will be seen from the illustration, the blower and motor are mounted upon the same base, so arranged that the distance between centres of the pulleys is adjustable by means of a belt tightener. The blower may be used for any of the various uses to which this class of machinery is adapted; it is also made by the company combined with a small vertical engine, mounted upon the same bed plate as the blower. The base frame on which the motor and blower are mounted is constructed of wrought iron angle beams, securely bolted at the corners and with holes drilled for anchor bolts of lag screws. Of course any type of motor may be fitted for use in this connection.



CAR FITTED WITH EICKEMEYER MOTOR.

The Eickemeyer Gearless Motor.

During the past year the gearless motor has gradually worked its way into considerable favor, and extensive experiments are now being tried with a number of varieties.

Our present illustration shows the Eickemeyer gearless motor car that is in use to-day in Toledo, O., and Lynchburg, Va. The motor truck as manufactured by the Western Electric Company, of Chicago, has already been illustrated in our columns.

Mr. Eickemeyer's machine is radically different from any of the other gearless motors that have appeared. In the first place, only one motor is used to a car and it is placed not upon either axle, but between them, and drives both sets of wheels by means of connecting rods, as shown in the cut. The crank disc on the armature shaft transfers the motive power of the armature to the axle. Singularly enough it is a two-pole machine, and is so designed as to give at a normal car speed of 10 miles per hour about 133 revolutions per minute. The maximum speed for which the motor is designed is 20 miles an hour.

The general arrangement, as our readers are already aware, is that of a series wound motor with commutated field coils. The armature is 14½ inches in diameter and 20 inches long.

As might be anticipated from the use of a two-pole machine, the weight is great, the 30-h. p. motor with its truck weighing 4½ tons, and the car body three tons additional, making a total of 7½ tons for the complete car equipment.

The car wheel is somewhat smaller than usual, a convenience in allowing a somewhat greater armature speed than would ordinarily be the case.

A number of these cars are now in use, and seem to have given considerable satisfaction. No tests of the efficiency of this type of motor have as yet been published, but Mr. Eickemeyer's well-known skill as an electrical designer is a sufficient guarantee of care in this direction.

The Chicago Electric Club.

On Wednesday evening of last week the rooms of the Chicago Electric Club were filled by nearly 100 members and prominent guests who had gathered to listen to the reading of Mr. Francis W. Parker's elaborate paper on "The Necessity and Present Opportunity for the Establishment of a Technological Institution with Physical Laboratory and Museum of Mechanical Arts in Chicago" and the discussion following thereafter. Mr. Parker's paper was a dignified, thoughtful and earnest appeal for the establishment of a technological school in the city whose present supremacy was so largely the result of engineering skill, and in a masterly manner he reviewed the principal factors that had contributed to this marvelous growth.

At the conclusion of Mr. Parker's paper Mr. B. E. Sunny, the chairman of the meeting and president of the club, opened the discussion by some remarks on "The Attitude of the Electrical Interests Toward the Proposed School," in the course of which he said:

"There has never been any lack in Chicago of what are known as 'practical electricians.' Any man of ordinary intelligence can, with a few months' experience, acquire a sufficient knowledge of the most intricate piece of electrical machinery to enable him to operate it successfully. But it too often happens that in a year, or even less, the 'practical electrician' has grown so much in courage and confidence that he criticises designs of machinery and feels competent to improve upon them. The story of the efforts of the average 'practical electrician' to make improvements on standard machines is a familiar one and worth repeating only to emphasize the necessity for theoretical as well as practical knowledge of electrical machinery on the part of those placed in charge of it.

"The pioneer work in placing and operating underground wires, especially high pressure wires, was done here in Chicago. The problem is simple now, but the experience was costly and severe. Electricity has in store for us some of its greatest wonders. Much is expected of it, and it is within the possibilities that the next few years will see it more broadly applied for the transportation of freight and passengers as a substitute for steam, a more general application for the transmission and furnishing of power at long distances, and by the use of high pressure currents, particularly in connection with the water power scattered throughout the western country; for the work of drilling, cutting, pumping and hoisting in mines, as well as for the minor applications that are being from day to day developed.

"At no point in the western country is there what can be regarded as a well-equipped school for the development of electrical engineers, and in the East there are but five, namely, the Sheffield, the Johns Hopkins, Cornell, the Stevens and the Massachusetts Institute of Technology. In all of them the electrical course receives the prominence that it merits. There are in all 1,100 students taking the electrical course, a number ridiculously inadequate to the requirements of the important work to be done. Electrical manufacturing companies will cordially support any movement looking to the establishing of an electrical school in Chicago. With proper educational facilities in Chicago the city would in a few years lead in the work of manning with skilled help the great electrical properties that are growing up all through the western country."

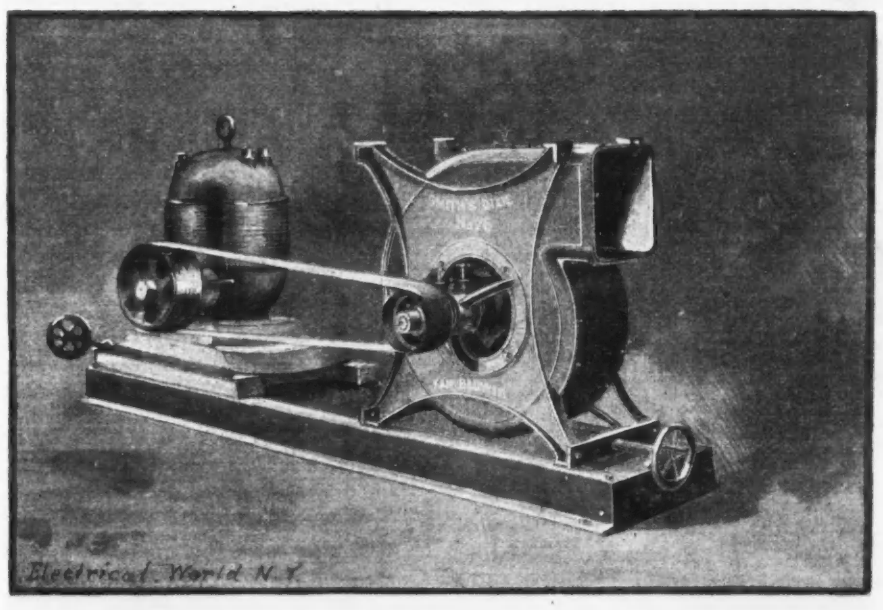
After some further discussion by ex-Mayor Roche, Prof. W. R. Harper, Mr. A. H. Revell, Rev. P. S. Henson and others, President Sunny appointed a committee of seven, consisting of F. W. Parker, chairman; W. J. Chalmers, R. C. Clowry, F. S. Terry, Elisha Gray, W. A. Kreidler and B. E. Sunny, to do all in their power to further the formation of a technological institute. The guests and members then adjourned to an upper room and enjoyed a dainty lunch.

McLain Snow Plow.

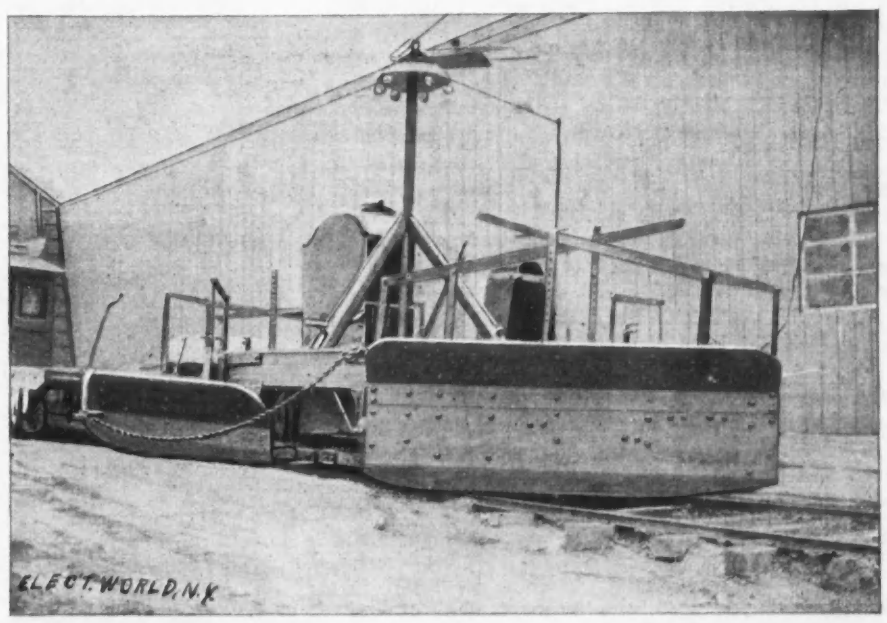
The illustration here given of a snow plow designed by W. R. McLain, master mechanic of the Des Moines (Ia.) Street Railway Company, is of special interest at this season of the year. It is fitted with scrapers at each end, as well as side wings to throw the snow a good distance from the track. The end wings are made of 1½-inch oak, with an iron edge on the bottom. Through the centre of the car runs a timber 7 × 14 inches. All braces are of iron 4 × ¾ inches, making the plow very strong in every part.

It is operated by two 15-h. p. Thomson-Houston motors. All the controlling apparatus is arranged on top of the plow in one small box, as is shown in the illustration.

The increasing number of street railways using electric power exclusively makes the snow plow driven by the same power a very desirable if not absolutely essential addition to the equipment of any railway having a considerable number of miles of track. The present winter, however, has not required the frequent use of the snow plow.



THE DIXIE BLOWER DRIVEN BY AN ELECTRIC MOTOR.



THE McLAIN SNOW PLOW FITTED WITH ELECTRIC MOTORS.

The blower is of the Dixie pattern, with feet on all four quarters of the case, so that it can be placed to discharge in any direction, vertically or horizontally. It is adjustable forward or back by means of the screw shown in the illustration, to which a hand-wheel is attached.

* "On a Property of Magnetic Shunts," Communicated to the Physical Society, April 17, 1891. See *The Electrician* (London), vol. XXVI., April 24, 1891, p. 764.

The Construction of Non-Inductive Resistances.

BY PROF. W. E. AYRTON, F. R. S., AND T. MATHER.*

With all the electric methods devised for measuring the power given by a varying current to a circuit that may possess inductance or capacity it is necessary to employ a resistance which shall have zero inductance, consequently it is important to consider how such resistances may most easily be made.

If the inductance of this nominally non-inductive resistance be not zero, the error thus introduced into the measurement can still be made relatively unimportant if the time constant of this portion of the circuit be made small. For, as shown by Dr. Sumpner and one of us, in a paper† read before this society on June 12th of this year, the following proportion holds true in all the nine methods of measuring power there considered:

$$\frac{\text{the watts as measured}}{\text{the true watts}} = \frac{1 + \tan\theta \,.\, \tan\varphi}{1 + \tan}$$

where θ and φ are the angles of phase difference between the current and the P. D. for the circuit the power given to which we desire to measure, and for the auxiliary circuit respectively.

Now for any given configuration of a circuit, the time constant will be the smaller the higher the specific resistance of the conductive material; hence it is very desirable to use a material of high specific resistance like carbon. For this reason, glow lamps constitute valuable small time constant resistances, but carbon has the disadvantage that its resistance varies rapidly with temperature. Hence, since with the methods of measuring power referred to it is necessary to know the resistance of the non-inductive circuit at the moment of making the measurement, it follows that if carbon be employed an extra measurement has to be made.

When the non-inductive resistance is put in series with the circuit the power given to which we desire to measure, as, for example, with the three-voltmeter method of measuring power, a measurement of the resistance of the glow lamps merely means the reading of an extra instrument at the moment the power test is made; but when the two circuits are joined in parallel, as, for example, with the one-voltmeter and two-ammeter method of measuring power, a measurement of the resistance of the glow lamps cannot be made simultaneously with the power test, since to do this would require the introduction of an ammeter, and therefore of inductance, into the circuit, which should be non-inductive.

Further, carbon is unsuitable for portable resistances on account of its brittle nature. Platinoid, on the other hand, is flexible, has a low temperature coefficient and a high specific resistance, though not of course nearly as high as that possessed by carbon. Platinoid therefore appeared to us to be the best material to employ in the construction of non-inductive resistances to be used for power tests.

It is well known that a wire doubled on itself has a very small inductance, which approximates to 3.77 times the total length of the wire in centimetres as the parts approach each other. This value can, as Maxwell pointed out, be reduced by using flat strips instead of round wires; and, if the strips be bare and be placed vertically, it is clear that the cooling action will be considerable, so that relatively strong currents will produce but little rise in temperature or increase of resistance.

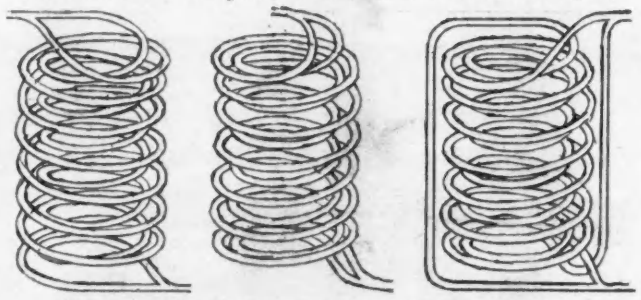
We therefore decided as early as 1887 to construct a non-inductive resistance consisting of twelve platinoid strips, each six metres long, four centimetres wide and 0.25 millimetre thick. Each strip is doubled on itself, two layers of carefully shellaced silk, 0.075 millimetre thick, being inserted between the front and back portions. The whole is bound together by means of a narrow silk ribbon wrapped round spirally, considerable gaps being left between the spires of the silk ribbon so that the platinoid should have plenty of free surface for cooling.

For the purpose of expelling moisture from the silk and the shellac varnish, when the resistance strips are first put up, a current was passed through each strip strong enough to make it fairly hot. During this heating frequent short circuitings occurred from rough points of the metal piercing the silk, a single layer only of which was originally employed to separate the front and back portions. An additional layer of silk was therefore inserted. Trouble was also experienced from the rough edges of the metal causing short circuits; but by cutting the silk wider than the metal and by folding the edge of the silk over the edge of the platinoid strip, this difficulty was overcome.

The double strips are permanently joined up in sets of three, and to the ends of each set are soldered mercury cups and binding screws. The four sets of three can be joined up in series, or in parallel, or in parallel series by bridge pieces dipping into the mercury cups, and when all are in series, the resistance of the 72 metres of strip at 15° C. is 2.932 ohms. The resistance of the arrangement does not alter by more than one-tenth per cent., when a current of 15 ampères is passing through each strip. The wooden frame which carries this series of plantinoid strips hangs on paraffined ebonite pegs attached to one of the laboratory walls, so that it is well insulated.

The inductance of the set of strips, even when all are in series, is so small that we have not been able to measure it even with the secohmmeter. Some of the tests have given indications of a small negative result, which, if true, would mean that the capacity effect slightly overbalanced the inductance; but a calculation which we have made appears to show that with the dimensions in question such a result is impossible. We can, therefore, only conclude that this resistance frame, which was constructed by two of our former students, Messrs. C. G. Lamb and E. W. Smith, fulfills the object for which it was intended so well that the inductance cannot be detected with certainty by any test that we have hitherto tried. We, therefore, have decided to duplicate the arrangement, the wooden framework having been constructed large enough to hold a second set of strips.

Another method of constructing non-inductive resistances for large currents, which has been in use at the Central Institution for the past 18 months, is illustrated in Fig. 1,



Figs. 1 to 3.—Construction of Non-Inductive Resistances.

Fig. 1.—Right and left-handed spirals in parallel opposing one another. Fig. 2.—Two right handed spirals in parallel assisting one another. Fig. 3.—Two right-handed spirals in parallel opposing one another.

and consists in winding two bare platinoid wires of equal length and thickness into two spirals, one right-handed, the other left-handed, the diameters of the two spirals differing slightly from each other so that one spiral can be placed inside the other. They are then connected up in parallel, so that when a current is sent through them it circulates clockwise round one spiral and counter clockwise round the other, the magnetic effects of the two thus tending to neutralize one another and to produce a combination with small inductance.

The inductance of coils constructed in this way is almost as small as if the wires were doubly wound like an ordinary resistance coil, *but they possess the great advantage that parts differing much in potential are not close to one another.* The wires therefore require no insulating covering, for no harm will occur if one spiral accidentally touches the other, provided that reasonable care has been taken to space the convolutions fairly uniformly. Further, as the

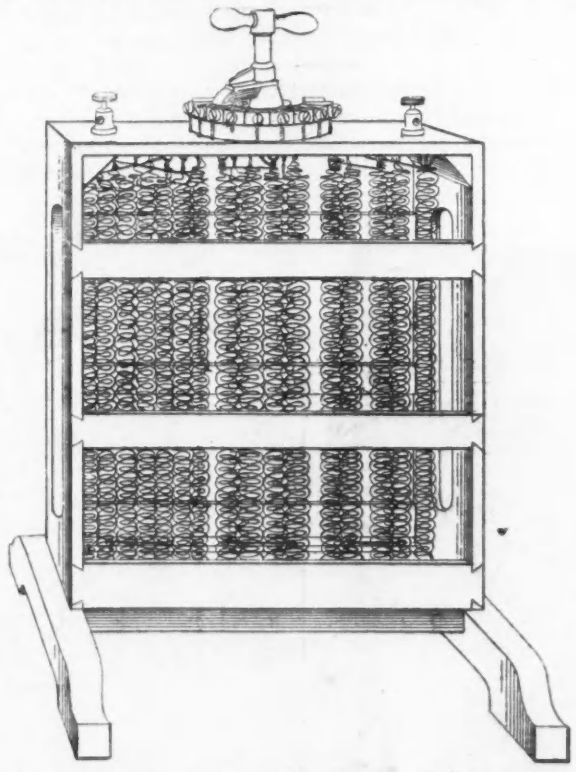


Fig. 4.—Construction of Non Inductive Resistances.

cooling surface, for a given total cross section of the conductor, is much greater for two concentric spirals than for a single spiral of thicker wire, it follows that this method of constructing a resistance not only greatly reduces the inductance, but also enables a much larger current to be carried for a given variation of resistance produced by the current. Hence for a given current and for a given permissible rise of temperature finer wire can be used; the coils can therefore be made shorter, and the inductance for this reason still further lessened.

Lastly, even when such right and left-handed spirals are traversed by a direct current, much less disturbance is produced in a neighboring delicate galvanometer than if a singly wound spiral resistance be employed; so that these right and left handed spirals of bare wire are valuable in the construction of resistance frames for large direct as well as for large alternating currents.

A number of portable resistance coils have been constructed in this way for general use in the laboratories of the Central Institution. One of these is seen in Fig. 4. It has also been found convenient to fit up a number of stationary right and left handed concentric spirals of platinoid in the dynamo laboratory, for use in the regular experiments with alternate currents.

Table I. gives the particulars of some portable sets of stand coils in the laboratories of the Central Institution, the second three of which have been composed of right and left handed spirals in the way just described and illustrated in Fig. 4.

Table II. gives the results of experiments made on the sets marked 2, 3, 4, 5, 6 by means of the secohmmeter, the set marked 6 being tested when each pair of coils were joined up in parallel so as to increase the inductance as well as when joined up so as to diminish it.

Table I.

Particulars of Portable Stand Coils.

Mark on the stand.	Resistance in ohms.	Number of spirals in the set.	Length of each spiral.	Number of convolutions in each spiral.		Outside diameter of the convolutions		Size of the wire (S. W. G.).
			inches.			inches.		
1....	1.8	6	18¾	78		1⅜		No. 12
2....	2.54	12	11½	63		1⅜		No. 10
3....	8.59	12	16½	74		1⅛		No. 13
				Outer.	Inner.	Outer.	Inner	
4...	1.4	20 double, that is 40 coils in all	10½	15	21	ins. 1⅛	in. ⅞	No. 13
5...	5.0	" "	12½	27	37	1⅜	⅞	No. 15½
6...	9.99	" "	17	54	79	¾	⅛	No. 27

Table II.

Portable Platinoid Spiral Resistances.

Mark on the stand.	Winding.	Resistance, in ohms.	Inductance, in secohms.	Time constant, in seconds.
2	Set of singly wound spirals	2.54	0.00059	23×10^{-6}
3	Set of singly wound spirals	8.59	0.00015	18×10^{-6}
6	Set of doubly wound spirals; current circulating in all in the *same* direction	98.1	0.021	21×10^{-6}
6	Same set of doubly wound spirals; current circulating in *opposite* directions	99.	0.00013	1.3×10^{-6}
4	Set of doubly wound spirals; current circulating in *opposite* directions	1.4	0.00004	2.8×10^{-6}
5	Set of doubly wound spirals; current circulating in *opposite* directions	5.0	0.00009	1.9×10^{-6}

The mean time constant, therefore, of one of our sets of spirals, whether singly wound or doubly wound, provided that the current circulates in all the convolutions in the same direction is about 21×10^{-6}; whereas, if the spirals be doubly wound, and the current be circulating in opposite directions in the two sets of spirals, the mean time constant is about 2×10^{-6}, or about one-tenth of the preceding.

As there happens to be in the laboratory a solenoid, the silk covered coppered wire on which is wound in a series of concentric sections, it was thought interesting to compare the time constant of two of the sections joined up in parallel, when the current circulated round both in the same direction, with the time constant when it circulated in opposite directions. Figs. 2 and 3 show the direction of the current in the two cases.

	Resistance, in ohms.	Self-induction, in secohms.	Time constant, in seconds.
Currents flowing round both coils in the same direction (Fig 4).	0.346	0.00059	17×10^{-6}
Currents flowing round the coils in the opposite direction (Fig. 5)	0.346	0.00024	0.69×10^{-6}

The self-induction and time constant have therefore been reduced to one twenty-fourth part by sending the currents in opposite directions round the two, but the method of winding shown in Fig. 3 could not, of course, be employed with the non-inductive resistances constructed of bare wire for large currents described in this communication, since the fundamental condition—*that parts differing much in potential should not be near one another*—would not be fulfilled.

Electric Lighting in Minneapolis.

Mr. W. E. J. Deming, electrical inspector for the city of Minneapolis, has recently completed an interesting compilation of the growth of electric lighting in that city during the past ten years. The result of his investigations is very interesting, and has been embodied in a report, the substance of which is as follows:

"The first electric light in Minneapolis was an arc light, run from a small Brush plant, in the Pillsbury 'A' mill and was started Dec. 24, 1881. This was followed by a ten-light United States (Weston) plant in the Big Boston clothing store, old Academy of Music, March 31, 1882. It is a singular fact that the local newspapers made no mention of these lights at this time.

"The first isolated incandescent plant was a United States (Weston), located in the Pillsbury 'A' mill in January, 1884. At the present time there are seven isolated arc

*A paper read before the Physical Society of London.

† "Alternate Current and Potential Difference Analogies in the Methods of Measuring Power," *Phil. Mag.*, August, 1891, p. 204.

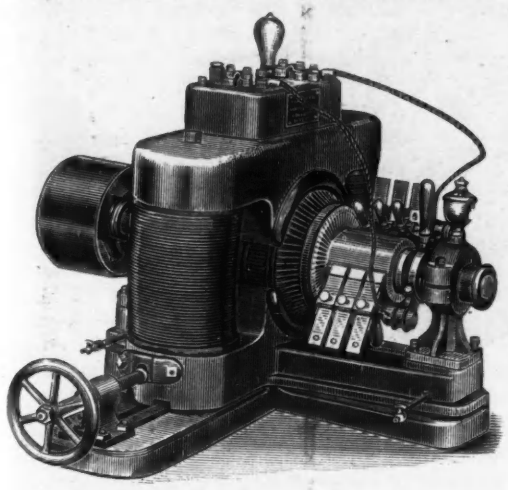
plants, running 380 lights, and 70 isolated incandescent plants, running 22,110 lights. The above includes 3,025 multiple series lights run by the street railway company.

"In 1883-4 a few incandescent lights were run from storage batteries charged from central station, but this soon proved a failure and they were abandoned. Prior to 1887 the only incandescent lights run from central stations were a few scattered groups of series multiple lights run on arc light circuits. About this time the furnishing of current for incandescent lighting for commercial purposes became an established fact, and at the present time there are 27,822 incandescent lights running from central stations, not including street railway lights.

"Electricity as a motive power was used to but a small extent in Minneapolis previous to 1890. At the present time there are 575 h. p. of motors in use, exclusive of the street railway and small fan and dental motors. The street railway company has 6,500 h. p. of motors in use, and this makes a total of 7,075 h. p.

"There are 1,803 arc lights running from central stations. Electric heating is in its infancy, and is not yet a perfect success, though about 8 h. p. of current are used for this purpose here, chiefly in laundries, hat stores and clothing factories.

"If the entire business in the city were reduced to incandescent lighting it would amount to 164,989 16-candle power lamps."



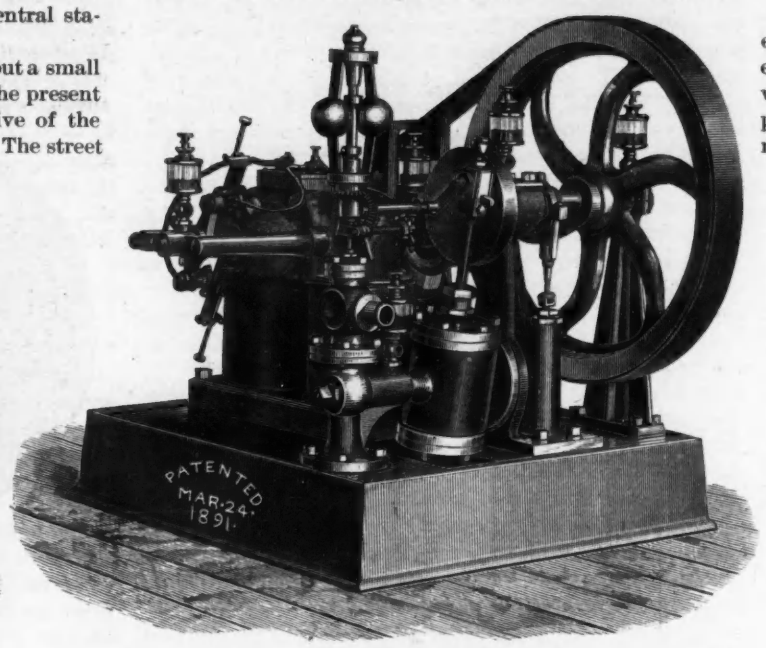
DUPLEX DYNAMO.

The Duplex Incandescent Dynamo.

The incandescent lighting generator illustrated on this page, is made by the Duplex Electric Company, of Corry, Pa. It has a capacity of six horse power. These machines are very similar to the company's motors, and vary from 15 to 500 lights of 16 c. p. They are built on a sliding base and are furnished with a belt tightener.

The regulation is secured by the winding. They are simple in construction and are said to be self regulating, thoroughly automatic, without the use of rheostats or other appliances outside of the generator, so that the extinguishing of any number of lights is followed by a corresponding decrease in the amount of current supplied by the dynamo. The armature used is a modification of the Gramme type. The core is drum shaped, built on a brass spider of the best charcoal wire. The armature is carefully balanced both before and after winding.

The commutator segments are of tempered copper, insulated by mica and firmly held in place by a fibre collar. The brushes are made of thin strips fastened together at one end. It is claimed that they do not require shifting and that they are free from sparking under extreme variations of load, thus insuring their long life. The bearings are made of the best anti-friction metal, while the supports are so attached to the pedestals as to secure perfect alignment.



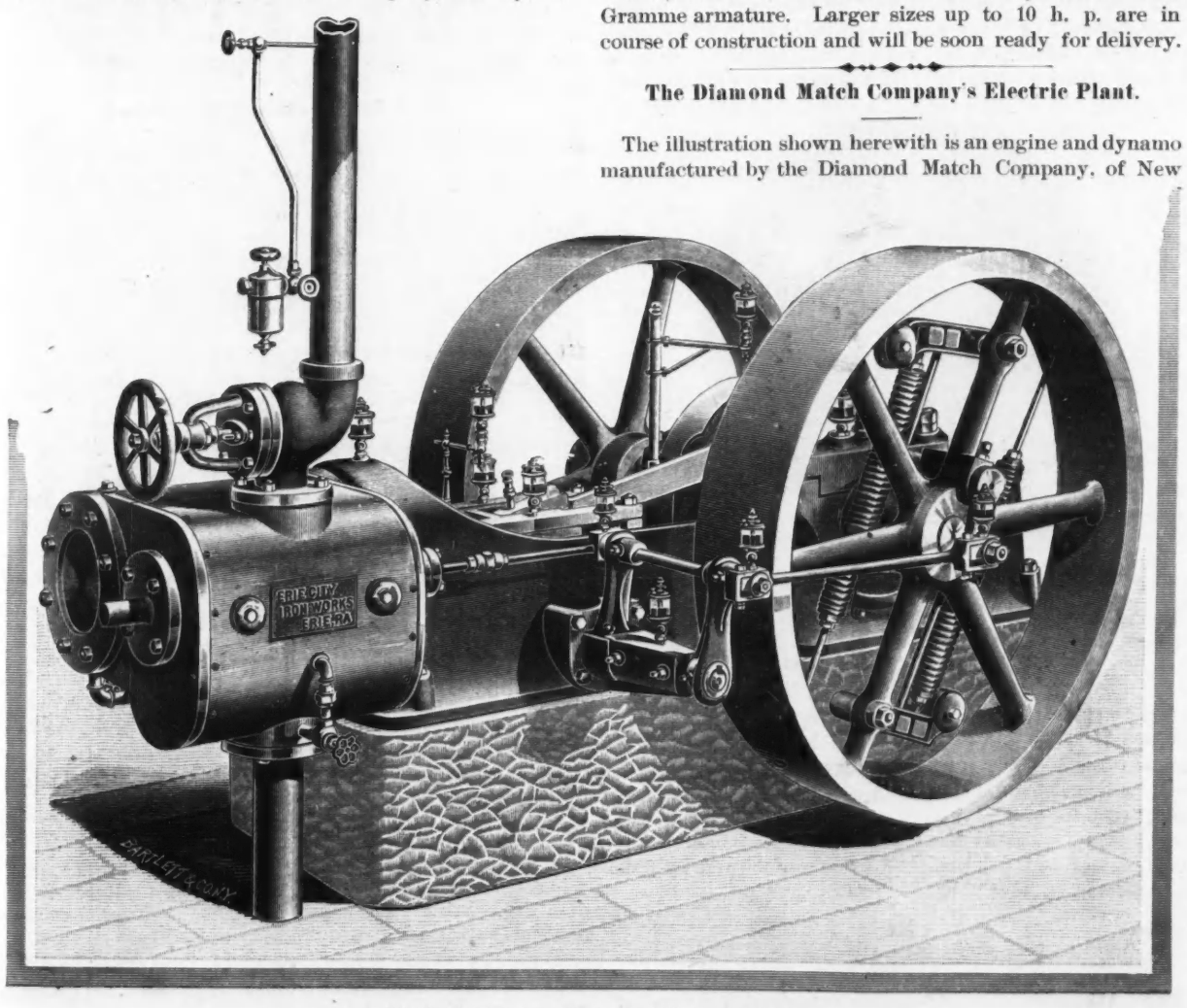
DIAMOND MATCH COMPANY'S ENGINE AND DYNAMO.

The Holtzer-Cabot Constant Speed Motor.

The motor illustrated herewith is manufactured by the Holtzer-Cabot company, of Boston. It is of the slow speed type and is said to be perfectly automatic in its operation. It is beautifully finished, is simple and well made in all its details. The sizes made are $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{2}$ and one h. p., and these are wound for any voltage or for battery circuits if desired. They are also wound for dynamo or plating purposes. Fan motors with two 12-inch fans, one on each end of the shaft, are furnished, if desired, as are also 500 volt $\frac{1}{2}$-h. p. motors with Gramme armature. Larger sizes up to 10 h. p. are in course of construction and will be soon ready for delivery.

The Diamond Match Company's Electric Plant.

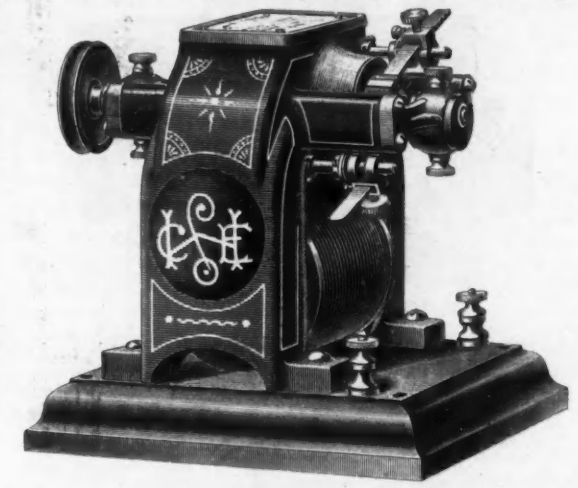
The illustration shown herewith is an engine and dynamo manufactured by the Diamond Match Company, of New Haven, Conn. It is a combination of *multum in parvo*, a complete electric light plant occupying a space less than two feet square. It is a new but well tested mechanical device for the generation of electricity for illumination by the incandescent system, made in all sizes from 10 to 100 lights. It was recently patented, yet not a new invention in its parts, but its combination is new and unique. The engine is of the oscillating type, with valve cutting off at two-thirds of the stroke and working one-third on expansion. The machine shown is of 20-light capacity, 1,600 armature speed. It is self regulating, is easily operated, and, it is stated, is adapted for steam yachts and steamships, for factory offices, stores, printing offices and, in fact, all places where steam can be obtained to supply it, where a perfect and good light is desired, and where a small electric plant can be utilized that combines cheapness with efficiency and durability.



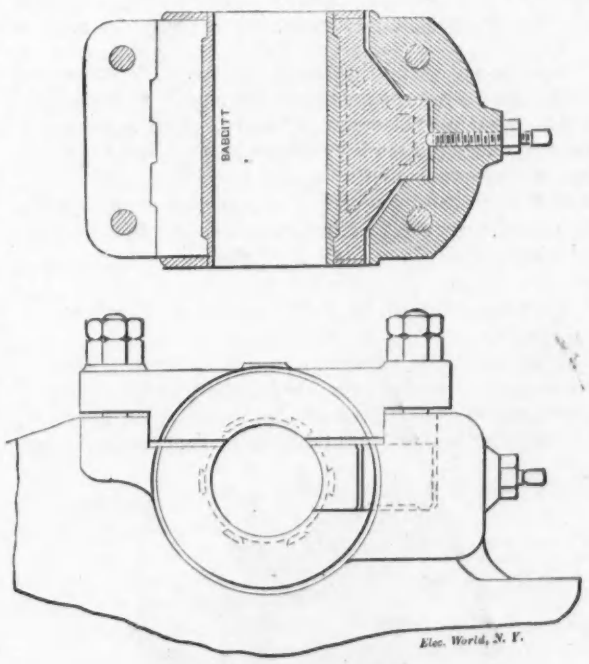
ERIE CITY IRON WORKS' ENGINE.

New Style Automatic Engine.

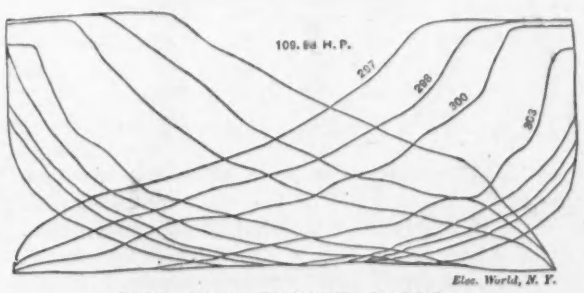
The illustrations show a new automatic high speed engine its journal bearing and some indicating card. This engine has a new style of automatic governor, and is made with a much heavier crosshead, longer and heavier slides, piston valves of larger diameter and a larger steam chest, made detachable from the cylinder, than in former patterns. A patent pillow block has also been applied on the main journal bearing, as will be seen from the cut. In the new automatic governor, which is a recent invention, the special features worthy of note are its simplicity, by which the liability to wear and get out of order, it is stated, is reduced to a minimum, and extreme sensitiveness and rapidity when in operation, there being no tendency noticeably to "hunt," "race" or flutter. By a recent patent the following features have been covered: The use of a rocker arm passing through the hub of the pulley of the engine, carrying on its outer end a pin moving in an eccentric path, for the purpose of actuating the valve, and the centre of this rocker arm placed so far to one side of an eccentric line as to make the path of this eccentrically moving pin travel not only in a larger circle with a heavier load, but to admit the steam quicker; in other words, increase the lead as the load on the engine increases. This feature, in combination with the weight arms of the governor on the pulley being made double so as to bring all the strain of the actuating parts square against the pins supporting the arms, and the making of the weights on the arms with separate detachable weight pieces marked to represent the number of revolutions they will give when placed on the engine



HOLTZER-CABOT MOTOR.



ENGINE BEARING.



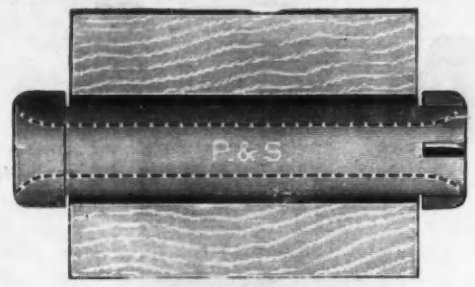
ERIE CITY ENGINE CARDS.

(as the weights are placed on Fairbanks or any other platform scale), constitute the principal claims of this patent.

It is manufactured by the Erie City Iron Works, manufacturers of steam engines and boilers, of Erie, Pa.

A China Wiring Tube.

For use in connection with concealed work, the china wiring tube made by Messrs. Pass & Seymour, of Syracuse, N. Y., is what has often been sought for by wiremen. The body of the tube, which is made of Syracuse china, is so constructed as to be an easy fit for the aperture in which it is to be inserted. On one end are several slight projections placed at irregular intervals, so that when the tube is inserted it cannot be withdrawn except in one position. The other end of the tube has an enlarged head. The tube can-



CHINA WIRING TUBE.

not be displaced when the wire is drawn through, and no tape is required to hold it in position.

Ceiling Rosette Cut-Out.

In the accompanying illustration is shown a new rosette cut-out, as manufactured by Messrs. Pass & Seymour, of Syracuse, N. Y. Its construction is clearly shown by the illustration. It is not necessary to remove a cap in order to renew the fuse, as one can see at a glance which fuse needs attention. For re-fusing it is only necessary to loosen the screw *A* by two or three turns, insert the fuse wire

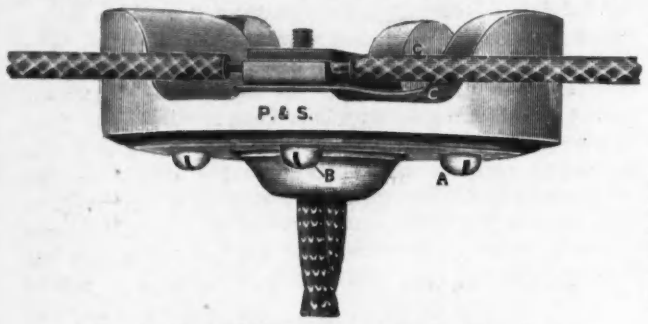


FIG. 1.—PASS & SEYMOUR'S ROSETTE CUT-OUT.

through the slot *C* and tighten the screw. The screw *B* is then loosened two or three turns, the fuse wire drawn under the clamp and the screw tightened. This is the whole operation and is easily accomplished in much less time than when it is necessary to insert the fuse wire under closely confined screws and washers. The cut-out is made of Syracuse china, a material extensively used by this company in this class of work.

An Improvement in Ball Compound Engines.

The accompanying diagrams are taken from a 250-h. p. cross compound engine recently installed in the station of the Edison Electric Illuminating Company, of Paterson, N. J. It was designed and built by the Ball & Wood Com-

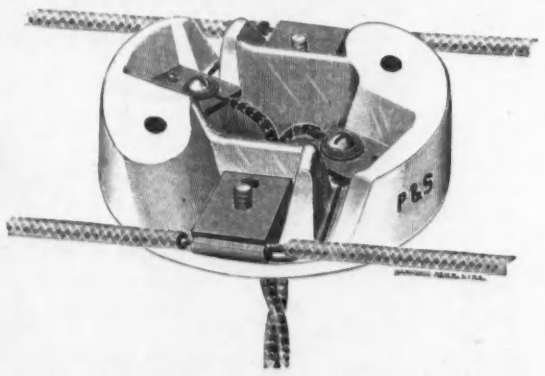
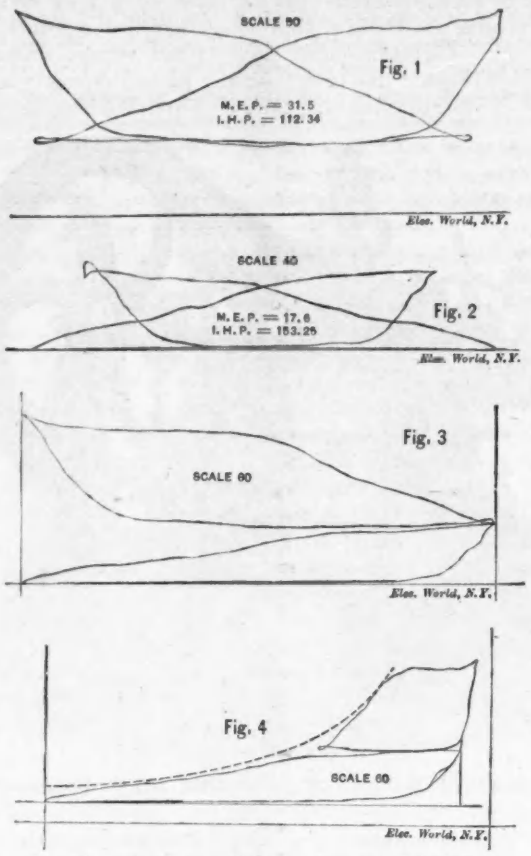


FIG. 2.—PASS & SEYMOUR'S ROSETTE CUT-OUT.

pany at their Elizabethport shops, and embodies some new features in the arrangement of low pressure valves. The steam chest of this cylinder is placed directly underneath, and contains two valves, both of which are double ported, giving large and direct ports with very small clearance. From the diagrams the efficiency of this arrangement can be seen. The dimensions of the cylinders are as follows: High pressure, 16 inches diameter by 16 inches stroke, low pressure, 25 inches diameter by 16 inches stroke; speed, 220 revolutions. Fig. 1 is a reproduction of cards from the high pressure cylinder, and Fig. 2 simultaneous cards from the low pressure cylinder. Fig. 2 represents a combination of the cards, showing their relations to each other and the measure of loss between the cylinders up to point of cut-off. In Fig. 4, the cards from both cylinders are referred to the low pressure cylinder in the usual manner, and show the efficiency of the system. The theoretic expansion and compression curves are shown in dotted lines. No tests of economy have yet been made, but the very small losses between the cylinders and in back pressure promises an excellent showing. This engine being the first of its kind, and not having been tested at the

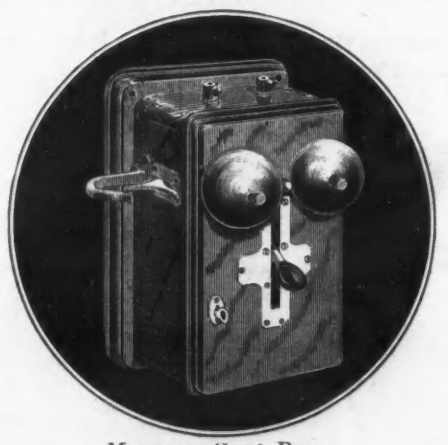


FIGS. 1 TO 4.—BALL ENGINE INDICATOR CARDS.

works for lack of time, considerable interest was manifested in its start, and quite a number of people assembled to witness its first move.

A New Magneto Call Bell.

The accompanying illustration shows a new call bell placed upon the market by the Viaduct Manufacturing Company, of Baltimore, Md. The New York office of the company is at 95 Broad street. It is claimed that this type of bell is quite an improvement over the old automatic hook construction, and can be used by telephone companies or by private lines in the United States without infringing any of the American Bell company's patents. The bell shown in the illustration is exhibited at the company's New



MAGNETO CALL BELL.

York office in Broad street mounted on a backboard with a battery box attached.

An Opener for Rim Locks.

We show in the illustration an electric door opener adapted to use with rim locks. It is constructed with special reference for guarding doors of offices, for gates at office railings, as it can be controlled by a push button, or can be used for operating yard gates of private residences and be easily operated from the house. It is compactly made, strong and efficient, and is manufactured by Edwards & Co., of New York.

Some New Edison Switches.

Quite recently, some very marked improvements have been made in its ratchet switches by the Edison General Electric Company, and some entirely new switches have been devised to meet the growing demand for small ratchet wall switches. These are of 5 and 10 ampères capacity, single pole. The bases and ratchets are of hard vitreous porcelain, manufactured by the Edison company at Schenectady. The ratchet is of peculiar construction, its sides being of unequal length. When the switch is "on," the shorter sides of the ratchet are presented to the contact brushes. These sides are rounded and the brushes specially curved, so that when the contact is made the brushes and contact sides of the ratchet fit with precision, thus forming a perfect contact. The ratchet itself is made of the best insulating material known. These switches are rendered instantaneous by an improvement introduced into the ratchet face. The cover is of metal which can be finished in any color, and is, therefore, peculiarly suitable for use in houses and buildings where artistic interior decorations are desired. The ratchet is removable and can be discarded in case of accident and another substituted, without destroying the entire switch.

The Edison General Electric Company has also adapted its whole line of ratchet switches to the special use of hospitals, asylums, steamships and elsewhere, where it is inadvisable to have other than responsible persons operating them. These special switches are furnished with a small

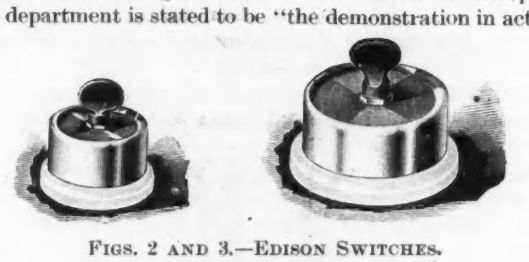
FIG. 1.—EDISON SWITCH.

collar fitting outside the cover and firmly screwed down upon the ratchet pin, which cannot be turned except by means of the key in the possession of a competent party.

The Schenectady works of the company have been compelled by the increasing demand for ratchet switches to enlarge considerably the department in which they are manufactured, and the facilities now possessed for turning out these switches are very great.

Prospectus of the Electrical Department of the World's Fair.

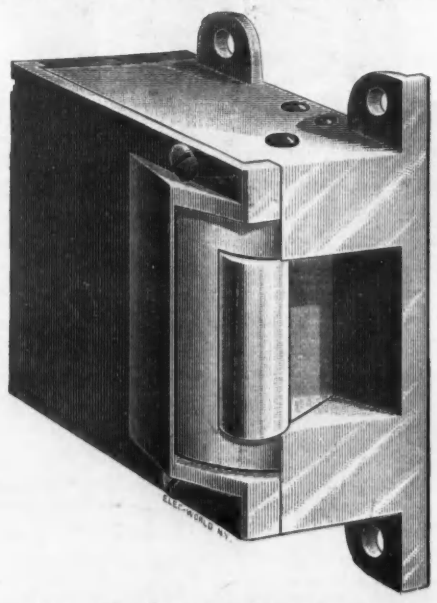
The prospectus of the Department of Electricity, which was issued on Saturday, is short but contains all the information that is thought needful for exhibitors. The scope of the department is stated to be "the demonstration in actual



FIGS. 2 AND 3.—EDISON SWITCHES.

operation of the commercial and economic applications of electricity; it is desired, however, to make exhaustive tests of electrical apparatus in all possible directions with a view to establishing their actual efficiency." Object lessons showing the delevopment of the science from its earliest stages by means of historical exhibits are also contemplated.

In relation to the lighting of the grounds it is stated that about 8,000 arc lamps of 2,000 c. p. nominal each and about 130,000 incandescent lamps of 16 c. p. will be needed. Besides this from 3,000 to 3,500 h. p. will be required for the



EDWARDS ELECTRIC DOOR OPENER.

operation of the machinery of exhibitors. This will be transmitted by electricity from the central power station. In relation to this central station the prospectus says, to furnish and transmit this 24,000 h. p. the Exposition company will construct a plant which, though a complete station in itself, will be composed of a number of smaller complete plants installed by those who contract to furnish certain parts of the service. These plants will be primarily for the service of the Exposition, but are not for that purpose prohibited from becoming competitive exhibits as well, provided the usual course is taken by their owners of mak-

ing the proper application of exhibitors through the office of the Director General.

Electric power, it is expected, will be used for the intermural railway that will constitute a part of the service of the Exposition, although this question has not been definitely settled. Arrangements for exhibition of electric cars in operation will also be made, although the necessary space has not yet been located. Displays of electrical mining machinery and electrical metal working machinery will constitute an important portion of the exhibits in the department.

In relation to artistic lighting effects the prospectus states that small chambers illustrating varied effects promise to be popular with exhibitors, and all proper aid will be extended by the department looking to the best possible results. The concluding paragraph of the general statement is as follows: "It is superfluous to add that every possible field of electrical work will be liberally considered, and that all systems of all countries will be placed as favorably as possible to the end that the best results may accrue to the electrical people and the public at large."

The Electrical Building is then described and also the manner of securing space by applying to the Director General of the Exposition. In reference to the installation of exhibits it is stated that all electrical apparatus excepting generators and the adjuncts of the generating plant must be shown in the Electrical Building, where electrical power only will be furnished. Generators to be operated by steam power cannot be installed in the Electrical Building, but will be located at some other point.

In refereace to the much talked about question of the relation of exhibits of dynamos and the service plant, the prospectus says that the power station will contain the plant under contract to serve the Exposition and will probably contain the generators of those exhibitors who contemplate exhibiting generating plants of sufficient capacity only to operate the balance of their exhibits in the Electrical Building, and steam power for the running of these generators will be furnished by the Exposition Company at a moderate price, the figures to be fixed hereafter. In the event that it may be found undesirable to combine the actual service machinery with the purely exhibitive generators some acceptable site will be found for the latter within reach of power. Appliances and apparatus, such as electrical elevators, search lights, etc., intended for exhibition, but offered and accepted for the service of the Exposition, may be installed wherever their service is required without forfeiture of their rights as competitive exhibits, provided that such outside location shall have been approved by the Director General.

Ample facilities will be provided for moving pieces of machinery weighing no more than 30,000 pounds. Any article weighing more than this will require an extra charge for installation. Empty packing cases may be stored at a maximum rate of two cents per cubic foot; with insurance, two and one-half cents will be charged for this service.

Foreign exhibits may be entered free of duty in bond. If sold the regular duty will be collected.

In conclusion, it is stated that the officers of the Exposition must for obvious reasons assume arbitrary power in acceptance of exhibits and the allotment of space. This power, however, will be exercised with the view to aiding the greatest possible number of exhibitors to make the most of the opportunity afforded by so great an Exposition.

Tesla Experiments and What They May Lead To.

The work done by Mr. Nikola Tesla, whose lecture at Columbia College is well remembered by American electricians, and who last Wednesday delivered a lecture at the rooms of the Royal Institution in London, as mentioned in the cable dispatch in this week's issue of THE ELECTRICAL WORLD, has naturally attracted much attention on both sides of the Atlantic. Mr. J. J. Carty, electrician of the Metropolitan Telephone and Telegraph Company of this city, talking with a reporter, suggests that by the use of a dynamo of sufficient capacity a current might be sent from the shore to a war vessel that would disable her crew and possibly even her machinery. "As a result of his experiments," added Mr. Carty, "Tesla thinks that there is a possibility of a man visiting the North Pole in perfect comfort and standing there without any clothing on, being warmed by this current of electricity. Now, it does not require any great stretch of the imagination to suppose that this heating influence could be increased so as to produce the most disastrous effects upon the crew of a war ship.

"I sometimes give myself up to the imagination of what the Ericsson monitor of the future may be in the case of a great naval war. If the suggestions which have come to me from the Tesla experiment are developed into practical value as an energy of war, it is possible to conceive of a float constructed with a large plate and a dynamo carried out into the stream or bay or ocean, guided from shore, and waiting for a war ship. When the war ship comes and presents its sides, perhaps a mile or more away, a current is established between the armor and the plate on the float."

"These waves will pass through fog, or even through a brick wall, and this fact alone would revolutionize the ordinary means of defense. I can give you a simple illustration. These electric waves will go through solid matter without injury, exactly as light goes through a window pane. You know that Prof. Bell sent a current of electricity over a wave of light which carried a telephonic message for a short distance, but the wave that he generated would be useless in case of a fog. In this case a fog or a stone wall would offer no resistance.

"Now, leaving the matter of war out of the consideration, it seems to me that these experiments may develop something of the highest value in the arts of peace. For instance, it would be perfectly feasible to generate a current of electricity which would penetrate a fog, and would be received by an apparatus on a steamship or vessel, and devices might be invented by which the wave would be enabled to communicate intelligence. The enormous factors contained in these suggestions are less appalling than would have been the idea of the construction of the steamship 'City of Paris' to ocean navigators and marine architects of the day of Columbus. There is, therefore, every reason to expect that in the future, and perhaps in the very near future, steamships will be provided with these apparatuses, and will be able to communicate with comparative ease at sea and through a fog. Some of the bottom principles in this suggestion have, in fact, already been made the subject of patents.

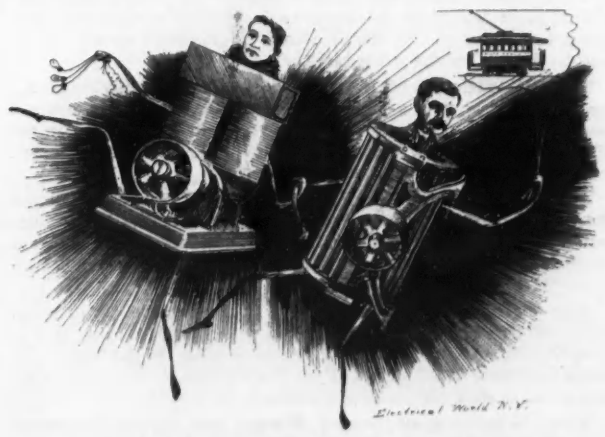
"Then again, a besieged garrison might be able to communicate with its army, using the earth as a medium for the electric wave. There is no doubt whatever of the feasibility of this. I can demonstrate it any day. I can give an illustration of something that happened to me in Buffalo which proves it. I was talking over a long distance telephone wire to friends in Cambridge, Mass., and I could hear with perfect distinctness the starting and stopping of the electric railway cars running through the streets of Cambridge. Perhaps a more remarkable illustration occurred in Paris, when certain noises produced in the electric light station in London were heard at the telephone in Paris, having been carried over a circuit through the earth."

Arrangements for the Buffalo Electric Light Convention.

Those who have enjoyed the luxuries of traveling by special train to former conventions of the association will be pleased to learn that arrangements have been perfected for a special vestibule train from New York to Buffalo for the convenience of those who attend the Buffalo meeting. This train will be composed of parlor, dining and buffet cars, and will leave the Grand Central Station at 11 A. M. on Monday, February 22, by way of the New York Central R. R. This train will connect at Albany with the Boston party. Seat checks for this train can be procured from Mr. C. O. Baker, Jr., Room 505, 136 Liberty street, New York City, at the rate of $2 each. Railroad tickets may be secured at the various ticket offices. It will be necessary, however, for the purchaser to request the ticket agent to furnish him with a certificate entitling him to rebate fare on his return passage. These certificates, Mr. Baker informs us, are made absolutely non-transferable.

Transportation matters in other localities than New York City are cared for by the following named persons: H. A. Cleverly, 1,018 Chestnut street, Philadelphia; Fred W. Royce, 1,408 Pennsylvania avenue, Washington; A. C. Shaw, 620 Atlantic avenue, Boston; John L. Martin, 148 Michigan avenue, Chicago; Morris W. Mead, Pittsburgh, Pa.; S. D. Nesmith, T.-H. Electric Co., Cleveland, O.; C. F. Hesser, Cincinnati Elec. Light Co., Cincinnati, O.; H. D. Stanley, Bridgeport, Conn.; Prof. Henry T. Bovey, McGill University, Montreal, Canada; N. U. Hart. New Orleans, La.; James I. Ayer, 322 Pine street, St. Louis, Mo.; Frederic Nicholls, Toronto, Canada; John I. Sabin, San Francisco, Cal.; E. W. Rollins, Denver Consol. Elec. Co., Denver, Col.

A determined effort has been made to make the programme of this convention a thoroughly practical one for central station men. The aim has been to cover every feature of central station management from the coal pile to the office. How well the officers have succeeded in securing a discussion of all these features is indicated by the following programme which has just been announced: "How to Fire a Steam Boiler," Richard Hammond; "The Allied Powers," Daniel Ashworth; "Switchboards, Their Safety and Operation," M. C. Sullivan; "Aerial Wires," E. F. Peck; "The Alternating Motor," Wm. Stanley, Jr.; "From the Tannery to the Dynamo," Chas. A. Schieren; "Underground Wiring," E. A. Leslie; "Underground Systems," J. B. Craven; "Municipal Franchises for Quasi-Public Works," Allen R. Foote; "Electric Lighting from a Financial Standpoint," Erastus Wiman.



JUPITER AND VENUS IN CONJUNCTION.

Mr. Carl Hering, of Philadelphia, will give an evening lecture on the "Transmission of High Potentials," based on the work done at Lauffen-Frankfort. Prof. Elihu Thomson, William Stanley, Jr.; H. Ward Leonard and others will take part in the discussion following the lecture.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.

BY P. F. MOTTELAY.

A. D. 1796——Gregory (George) D. D., F. R. S., Vicar of Westham, a miscellaneous writer of Scotch origin, for many years editor of the "New Annual Register," is the author of "Economy of Nature, etc.," of which the second and third editions, considerably enlarged, appeared respectively in 1798 and 1804.

In the first volume of the last named edition (book 1, chap. VI., pp. 35–54) he treats of natural and artificial magnets and of magnetic powers and theories of magnetism, while the whole of book IV. (chap. 1, VIII., pp. 299–386) is devoted to the history of and discoveries relative to electricity, its principles and theories, as well as to electrical apparatus and electrical phenomona and to galvanism or animal electricity.

Gregory is also the author of "Popular Lectures on Experimental Philosophy, Astronomy and Chemistry; Intended Chiefly for the Use of Students and Young Persons," two vols., 12mo, published in London 1808-1809, one year after Dr. Gregory's death.

It was the perusal of the latter work which led Joseph Henry to embrace a scientific career, just as the reading of "Mrs. Marcet's Conversations on Chemistry" had induced Michael Faraday to enter the field in which he afterward became so highly distinguished. Prof. Asa Gray, in his Biographical Memoir of Henry, says that the work alluded to is an unpretending volume but a sensible one, and that it begins by asking three or four questions, such as these: "You throw a stone, or shoot an arrow into the air; why does it not go forward in the line or direction that you give it? Why does it stop at a certain distance and then return to you? . . . On the contrary, why does flame or smoke always mount upward, though no force is used to send them in that direction? And why should not the flame of a candle drop toward the floor when you reverse it, or hold it downward, instead of turning up and ascending into the air? . . . Again, you look into a clear well of water and see your own face and figure as if painted there? Why is this? You are told that it is done by reflection of light. But what is reflection of light?" As Prof. Gray remarks, young Henry's mind was aroused by these apt questions, and allured by the explanations. He now took in a sense of what knowledge was. The door to knowledge opened to him, that door which it thence became the passion of his life to open wider. The above named volume is preserved in Prof. Henry's library, and bears upon a fly leaf the following entry:

"This book, although by no means a profound work, has, under Providence, exerted a remarkable influence upon my life. It accidentally fell into my hands when I was about sixteen years old, and was the first work I ever read with attention. It opened to me a new world of thought and enjoyment; invested things before almost unnoticed with the highest interest; fixed my mind on the study of nature, and caused me to resolve at the time of reading it, that I would immediately commence to devote my life to the acquisition of knowledge. J. H." (See Prof. A. M. Mayer, "Eulogy of Joseph Henry," Salem, 1880, pp. 29–30; Smithsonian Report, 1878, pp. 145, 146.)

See also *Gentlemen's Magazine*, vol. LXVII., p. 415; Beloe's "Sexag.," II., 128; "Living Authors" (1798), I., p. 225.

A. D. 1797.——Bressy (Joseph), French physician and able chemist, remarks, in his "Essai sur l' électricité de l'éau," that the electric fluid is composed of three beams (*rayons*, i. e., rays, gleams, or sparks), vitreous, resinous and vital; that three principal agents exist in nature, viz., the air, isolating body; the water, conducting body, and movement, determining action; that vapors resolve themselves into clouds merely because friction enables the electric fluid to seize upon the aqueous molecules, and that, in water, the hydrogen is maintained in the form of gas by the electric fluid, while the oxygen becomes gaseous under influence of the caloric.

See Larousse, "Dict. Univ.," vol. II., p. 1,236; Delaunay, "Manuel, etc.," 1809, pp. 15, 16.

A. D. 1797.——Treméry (Jean Louis), a French mining engineer, communicates his observations on elliptic magnets through Bulletin No. 6 of the "Société Philomathique" and the sixth volume of the *Journal des Mines*.

His observations on conductors of electricity and on the emission of the electric fluid appear at p. 168, vol. XLVIII., of the *Jour. de Phys.*, and in "Bull. de la Soc. Philom.," No. 19, while his views in opposition to the two-fluid theory are to be found in Bulletin No. 63 of the last named publication as well as in *Jour. de Phys.*, vol. LIV., p. 357.

See Poggendorff, vol. II., p. 1,131; John Farrar, "Elem. of Elec., etc.," p. 120.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 8, 1892.

The stock market of the past week has been one of declining and unsteady conditions, in marked contrast with the preceding week, when everything on the list had an upward tendency, and the outlook was very favorable for both investors and traders. The bears apparently had it their own way, and prices touched minimum figures. One recognizes many strong points in the market, which are valuable in transmitting a certain rallying power after the bears have done their best to hammer down the prices; but the prevailing sentiment is bearish, and that is indicative only of an irregular market, which does not invite investors.

The money market, which has been so easy for the past few weeks, is again strengthening, and the rates are gradually becoming higher. Among the banks money loans at 3 per cent. to 3½ per cent.; commercial call loans bring 3½ per cent. and 4 per cent., and time loans range at about 5 per cent. The financial situation cannot become settled while the present feeling of uncertainty exists on the silver coinage question. The Congressional committees will report next week, the House in favor of free coinage, and the Senate against it. There are such immense reserve funds lying stagnant at present, for lack of a good commercial market to use them, that the uncertain issue of this coinage question has an influence to unsettle the speculative markets, even though the final results may not prove as unfavorable to monetary conditions as is now feared in anticipating them.

The Electric Stocks have been the only exceptions on the list, and while all the other stocks have steadily declined on a market that was weak and uncertain, these stocks have boomed with a great wave of excitement. This has notably been the case with Thomson-Houston. For some weeks there has been steady buying of this stock, and the price has remained practically unchanged through the varying conditions of the general market. On Monday it opened two points higher than it had closed on Saturday, and gained four points in about ten minutes. The bears forgot their work on the other stocks, and were anxious only to be in the line of the one stock that was booming. The sudden rise suffered a slight reaction, but the prices for the week show a steady advance even over Monday's prices, and finally reached 59¼, selling ex dividend of one dollar per share. Fort Wayne stock rose in sympathy to 15, and has maintained a good price together with its parent company.

The rumors of a consolidation of the Edison and Thomson-Houston companies had a marked effect upon the stock trading of both companies, each occupying a conspicuous position both in New York and Boston. A consolidation of these companies, which now practically control the electric manufacturing business in this country, will settle existing disputes on patent cases of mutual interest.

Capitalization of the Edison and Thomson-Houston Companies.—The Edison company is capitalized at $13,849,400, of which $9,370,700 is issued, $2,478,700 held in trust, and $2,000,000 represented by stock notes. The Thomson-Houston company has $6,000,000 of common stock, and $4,000,000 of preferred stock outstanding, with the authority to issue $4,000,000 more of common, and $1,000,000 more of preferred. The fiscal year of the company ended Jan. 31, 1892. It is stated the net earnings will approximate $3,300,000. Dividend requirements for the preferred stock, seven per cent. on $4,000,000, calls for $280,000. This would leave a balance of $3,020,000 for the $6,000,000 of common stock outstanding, or, in the fiscal year ending Jan. 31, 1892, the company earned the full seven per cent. on the preferred stock, and 50 per cent on the common, or $12.30 per share. The dividend which it has been paying has been $4 per share per annum. Edison stock sells at 95 to 105, par being 100. Thomson-Houston stock sells at 59, par being 25. About 45,000 shares of Thomson-Houston stock were bought and sold on the Boston Stock Exchange during the week, and about 11,000 shares of Fort Wayne stock during the same time. The stock was bought by the leading banking houses on the street, who always have the credit of working for the "insiders." The Edison stock on the New York Exchange was slower to feel the influence of the deal, more particularly because the buying orders found no stock for sale. It reached 105 at the end of the week on a few sales.

Telegraph Earnings.—The Central & South American Telegraph Company's receipts in January were $79,820, an increase of $42,036 over January, 1891, and $62,880 over January, 1890.

Telephone Earnings.—The Cleveland Telephone Company, the Northwestern Telephone Exchange Company and the Southwestern Telegraph and Telephone Company have earned as follows for the quarter ended Dec. 31:

	1891.	1890.	Increase.
Gross income	$222,486	$203,374	$19,112
Total surplus	15,620	7,996	7,624
Total subscribers connected Dec. 31	14,011	13,147	864

Electric Bonds.—The North Attleboro Steam and Electric Company is paying its bonds, due Feb. 1, through the International Trust Company, of Boston. Subscriptions are also received there for a new issue of 20-year six per cent. bonds. Minneapolis Street Railway Company and St. Paul City Railway Company five per cent. bonds are being placed by leading banking houses in New York and Boston. The circular offering these bonds shows that the gross earnings of the Twin City Rapid Transit Company, which operates the combined roads, in 1891 were $1,820,592 gross and $310,975 net. The earnings per annum have increased 32 to 34 per cent. for 13 years. The Lynn & Boston Street Railway Company is authorized to issue $300,000 20-year five per cent. coupon notes, to be used in paying the floating debt and for construction.

Dividends.—Dividends have been declared by the following companies: The Central Traction Company, Pittsburgh, Pa., stock dividend of five per cent., or $2.50 per share; the Bangor (Me.) Electric Light and Power Company, semi-annual three per cent.; dividends of the Southern New England Telephone Company for the past nine months aggregated $45,000; the International Bell Telephone Company, Limited, New York, extra dividend of 25 per cent., payable Feb. 15.

Increase in Capital Stock.—The following company has increased its capital stock: The Worcester (Mass.) Consolidated Street Railroad Company, authorized by the Railroad Commissioners to increase capital stock by $350,000. The Louisville (Ky.) City Railway Company contemplates increasing by $600,000 for extensions to its plant, etc. The Plymouth (Mass.) and Kingston Street Railway Company contemplates an increase from $35,000 to $100,000. Alexander, Barney & Chapin, of New York, voted to increase capital stock by an issue of $50,000 preferred stock bearing interest at eight per cent.; the Penacook (N. H.) Electric Light and Power Company, from $10,000 to $15,000; Bergmann Gas and Electric Fixture Company, New York, from $100,000 to $150,000.

Annual reports of the following companies have been filed: Brush Electric Light Company, of Rochester, N. Y., capital stock paid in $250,000, assets $622,597.91, liabilities $253,227.81; Rochester Electric Light Company, of Rochester, N. Y., capital stock $250,000, paid in $150,000, assets at least $300,937.88, liabilities not to exceed $146,000; the Bell Telephone Company, of Buffalo, N. Y., capital stock $1,000,000, $535,000 paid in, debts not to exceed $1,201,619.27, assets $1,170,381.63; the Brockport, N. Y., Electric Light Company, capital stock $15,000, assets $30,954.89, debts $7,801.57, receipts $7,126.98, expenditures $7,080.08; Thomson-Houston Electric Light and Power Company, of Buffalo, N. Y., capital stock $500,000, of which $400,000 has been paid in, assets $400,000, debts $109,274.64, Edison Illuminating Company, Detroit, Mich., capital stock $300,000, paid in $230,000, real estate $32,791.55, personal estate $231,131.52, debts $24,451.05, credits $10,694.56.; the Southern New England Telephone Company, receipts $272,927, expenses $216,047; Southwestern Telegraph and Telephone Company, capital $2,000,000, debts $30,000, assets $30,000; Erie Telegraph and Telephone Company, capital $5,000,000, $4,500,000 paid in, debts $135,000, assets $135,000; Hudson River Telephone Company, capital $2,000,000, debts $110,000, assets $380,000; Norwich Illuminating Company, Capital $50,000, of which $20,700 is paid in, debts $116,060.05, assets, $104,522.38.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Feb. 6, 1892, in New York and Boston:

NEW YORK QUOTATIONS.

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	$6,200,000	87	87¼
American Telegraph & Cable	100	14,000,000	....	....
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	..	....
Commercial Cable Co	100	7,716,000	....	33
Postal Telegraph Cable	100	5,000,000	28	
Edison General Electric	100	15,000,000	101½	102½
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co., of New York	100	4,500,000	81	82
" " " Brooklyn	100	750,000	74	78½
" " " Boston	100	1,263,500	100	105
" " " Chicago	100	750,000	135	145
U. S. Illuminating Co	100	1,250,000	30	35
North American Phonograph Co	..	....	4	6
New York Phonograph Co	100	6,200,000	2½	5
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
" " " " bonds	sh	30,000	65	75½
" Ore Milling Co	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co	10	1,000,000	....	
U. S. Electric Light Co	100	1,500,000	15	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co	..	500,000	....	60
East River Electric Light Co	100	1,000,000	....	60

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec	25	6,000,000	59½	52	59	59¼*
Thomson Houston Elec. preferred	25	4,000,000	28½	27	28¼	28½
Thomson-Houston Elec.—Series C	sh	40,000	....	....	7⅞	....
Thomson-Houston Elec.—Series D	sh	120,000	7¼	7	7⅛	7¼
Thomson-Houston Int'n'al Elec	100	600,000	....	....	75	200
Thomson-Houston Int'n'al Elec—Pfd	100	400,000	....	....	101	104
Thomson Elec. Weld	100	1,000,000	....	....	55	....
Thomson European Elec. Weld	100	1,500,000	12½	....	12½	15
Westinghouse Elec.—Pfd	50	10,000,000	20½	20	20	....
Westinghouse Elec. —Trust receipts	..	....	13	12½	13	13¼
Fort Wayne Elec	25	4,000,000	15	13	14	14⅛
Fort Wayne Elec.—Ser A.	sh	80,000	7⅛	....	7⅛	7¼
Detroit Elec	10	1,000,000	8¼	....	..	8¼
West End St. Ry. Co.—Com	50	7,150,000	....	....	73	73½
West End St. Ry. Co.—Pfd	50	6,400,000	....	....	84¾	85
American Bell Tel	100	15,000,000	210	209	209½	210
Erie Tel. & Tel. Co	..	.....	46¾	46	46	46½
Mexican Tel. Co	..	.....	....	....	1	110
New Eng. Tel. & Tel. Co.	..	.....	51	50	50	51
Tropical Tel. Co	..	.....	....	....	40	45

*Ex-dividend.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$225@ $227	Cumberland	$60@ $62
Central Union	54@ 56	Wisconsin	118@ 120
Michigan	81@ 83	Bell of Missouri	175@ 180
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri & Kansas	50@ 53
Rocky Mountain Bell	40@ 43		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$84@ $86	Chicago Edison Co	$140@$142

NEW INCORPORATIONS.

The Standard Electric Light and Power Company, of Montpelier, Vt., has purchased a controlling interest in the Montpelier Gas Light Company.

The Westchester Telephone Company, of New York, will hold its annual meeting at 18 Cortlandt street, at noon on March 3, for the election of directors, etc.

The American Electrical Company, of Chicago, Ill., with a capital stock of $500,000, has been formed to manufacture, buy and sell all kind of electrical devices. The incorporators are Eben Carpenter, Arthur B. Eads and Alonzo P. Connolly.

The Ephrata Light Company, of Ephrata, Pa., with a capital stock of $10,000, has been organized to supply light, heat and power by electricity. The incorporators are John F. Mentzer, Andrew Baker and Charles Wise, all of Ephrata.

The Doylestown Electric Company, of Doylestown, Pa., has been formed with a capital stock of $16,000, to supply light, heat and power by electricity. Alfred Paschall, Wm. H. Kirk and Fred. Tibbils, all of Doylestown, are the promoters.

The City of Pekin Electric Light and Power Company, of Pekin, Ill., with a capital stock of $15,000, has been incorporated to furnish electric light and power to the city and citizens of Pekin. John R. Seibert, George Herget, Jacob A. Roelfs, Thomas Cooper and L. Zinger are the promoters.

The Millville Electric Light Company, of Millville, N. J., has been formed, with a capital stock of $50,000, to manufacture and supply light, heat, power and sound by electricity or other means. Francis Reeves, H. D. Kemble, both of Millville, and Walter Wood, of Philadelphia, are the promoters.

The Enterprise Mining, Milling and Smelting Company, of Seattle, Wash., capital stock $1,000,000, has been incorporated to deal in and operate mines, etc., gas and electric light and water-works. E. J. Thorp, J. C. Allen, J. J. Snyder, C. J. Klemme and F. F. Boynton are the promoters.

The Pink Granite Company, of Alexandria, Va., capital stock $200,000, has been formed to quarry granite, etc., erect telegraph, telephone, water, gas and electric works. B. E. Shear, J. A. Walter, both of Washington, D. C.; C. C. Clements, F. B. Arendell and A. G. Walter are the incorporators.

The Washington Lime, Brick and Manufacturing Company, of Spokane, Wash., with a capital stock of $50,000, has been incorporated to manufacture brick, lime, build houses, etc., operate gas and electric light and waterworks, railroads, etc. Joseph H. Spear and Henry Book, both of Spokane, are the organizers.

The International Chemical and Gas Company, of Chicago, Ill., has been incorporated, with a capital stock of $2,000,000, to manufacture, refine and sell oil, etc., refine ores and metal, manufacture and sell machinery and appliances for electrical and other purposes. The promoters are John Schwender, Sidney C. Eastman, and Max Baird.

AFFAIRS OF THE COMPANIES.

The Mobile (Ala.) Street Railway Company has been placed in the hands of T. G. Outlaw, receiver, who has given a bond of $50,000 and qualified.

The Fort Dodge Gas Company, of Fort Dodge, Ia., has absorbed the Thomson-Houston Electric Light Company, it is stated, and will operate both plants.

The Bell Telephone Company, of Missouri, will hold its annual meeting in St. Louis Feb. 16th, for the election of directors and the transaction of other business.

The Allegheny County Light Company, of Pittsburgh, Pa., held its annual meeting Feb. 9th, for the election of directors and the transaction of other business.

The Newport (R. I.) Street Railway Company at a recent meeting received the reports of its president and treasurer, showing that the finances of the company were in a most satisfactory condition. The old board of directors was re-elected.

The Sandy Hill Electric Light and Power Company, of Sandy Hill, N. Y., has the following officers: J. E. Howland, president; Marcus C. Allen, vice-president; G. M. Ingalsbe, secretary; Chas. T. Beach, Treasurer; Marcus C. Allen, Purchasing agent.

The Grand Forks Gas and Electrical Company, of Grand Forks, N. Dak., at its annual meeting elected A. S. Brooks, president; W. J. Murphy, vice president and general manager; A. C. Labric, secretary; H. L. Whithed, treasurer; T. Roycraft, superintendent. The capacity of the plant is to be doubled.

The Edison General Electric Company is negotiating for a building in Atlanta, Ga., for the purpose of fitting up quarters for carrying a large stock of electrical supplies. The new quarters will be fitted up and decorated in a magnificent manner, it is stated, to correspond with the New York and Chicago buildings.

The Belt Line Electric Street Railway Company, of Utica, N. Y., has gone into the hands of C. F. Benton, receiver. The liabilities of the company include $500,000 first mortgage bonds; $130,000 second mortgage bonds; $70,000 due creditors, with actual assets $155,000. It is stated that 750 shares of the company are owned by the Thomson-Houston company and the balance by capitalists in New York.

The Grand Rapids Water and Electric Power Company, of Grand Rapids, Minn., recently incorporated, has perfected an organization and elected Mr. J. P. Sims, of Minneapolis, president. The incorporators comprise several capitalists of Minneapolis, Duluth, St. Paul, Brainerd and Grand Rapids. The company contemplates utilizing and improving the water power of Pokejama Falls and furnishing electric power.

The St. Louis (Mo.) Electrical Exchange at its recent meeting perfected the organization under the charter granted by the State by electing officers as follows: A. C. Wolfram, president; J. Van Nort, vice-president; J. Holdsworth, treasurer; Edward T. Cook, secretary. The by-laws of the exchange will be submitted for approval and acceptance at the next regular meeting. A committee was appointed to decide upon a lecture course.

The Edison Electric Illuminating Company, of New York, in its annual report for the year ended Dec. 31, 1891, shows: Gross, 1891, $409,064; 1890, $283,551; net, 1891, $166,796; 1890, $108,213. Incandescent lamps in service, 55,286; increase, 15,300. Motors in service, 2,533 h. p.; increase, 1,002. Stock and convertible debentures were issued amounting to $690,000, bringing total capitalization up to full amount authorized, $2,000,000. Dividends have been increased from 6 to 8 per cent. The directors have petitioned the Legislature for authority to increase the capital stock to $5,000,000.

The Missouri and Kansas Telephone Company held its annual meeting in Kansas City recently, and the following officers and directors were elected: President, J. R. Mulvane; secretary and superintendent, W. W. Smith; treasurer, N. R. Ferguson. Directors: J. E. Hudson, Boston; G. Albree, Boston; C. E. Yost, Omaha; J. R. Mulvane, E. Wilder and T. B. Sweet, Topeka; S. A. Walker, St. Joseph; J. S. Chick, N. R. Ferguson, Kansas City. It was decided that an effort should be made at once to have the Council pass an ordinance authorizing the company to put its wires under ground. The company has secured a new exchange building, where it will have operating rooms of double the capacity.

The United States Electric Light Company, of Buffalo N. Y., and the Thomson-Houston Electric Light and Power Company have consolidated. It is stated that the name of the United States Company is to be dropped and one set of general officers will conduct all the business. The officers of the consolidated company will be the present officers of the Thomson-Houston company until April, unless they resign. It is understood that C. Lee Abell, treasurer and manager, does not care to serve in that capacity after an opportunity is had to name a successor. The other officers are: George Urban, Jr., president; William W. Sloan, vice-president; James A. Roberts, secretary; George Urban, Jr.; James A. Roberts, Philip Bachert, W. W. Sloan, Edward Michael, C. Lee Abell, Richard K. Noye, directors. To these directors will be added all but one of the following: John L. Williams, Charles A. Sweet, Franklin D. Locke, Daniel O'Day, Peter P. Miller, S. F. Eagan and John Donaldson.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Feb. 8, 1892.

Mr. Frank Meyers has resigned his position as superintendent of signals on the New York Central and Hudson River Railroad, to accept a lucrative position with the Hall Signal Company, 50 Broadway, N. Y.

The Strike of the Employes of the Edison Electric Illuminating Company shows no new features, and notwithstanding the efforts of the strikers, the company so far has been able to care for its patrons without any interruption in its service.

Doubleday, Mitchell & Co., have succeeded Parmly Mitchell & Co., dealers in electrical supplies, 18 Cortlandt street, New York. Mr. C. F. Parmly withdrawing. The members of the new firm are Chas. D. Doubleday and P. W. Mitchell, and they will continue to handle the specialties manufactured by the Consolidated Electric Company, the celebrated Columbia lamp, etc.

The New York Electrical Society will hold its next meeting on the evening on the 17th inst., at the Western Union Telegraph Building, 195 Broadway. The new operating rooms of the company will be open for inspection. A large attendance is expected. An invitation will be sent to the members of the American Institute of Electrical Engineers.

Mr. H. K. Lee, mechanical engineer, of Mt. Carmel, Conn., called at our office on Friday of last week. Mr. Lee makes a specialty of isolated lighting, electrical supplies and complete steam plants, and is sales agent for the Buckeye engine. He will bring out a new motor within a short time, which will be wound for 50 volts and will embody some new features in construction.

Mr. Alfred E. Kornfeld who has been favorably known in the electrical fraternity as an attache of THE ELECTRICAL WORLD, has recently perfected arrangements whereby he becomes business manager of the Himmer and Anderson Dry Battery Company. Mr. Kornfeld is one of the rising young men in the business, and with his energy and business ability the combination will be a success.

The East River Electric Light Company has transmitted to the Mayor copies of correspondence between the company and the Subway Company, showing that the cost of subway rentals to the East River Company was 32 cents per light per night on Fifth avenue. The company some time ago submitted to the Gas Commission a bid of 60 cents a night per lamp for lighting the avenue, and the bid was laid over. The Commission wanted the company to come down to 40 cents per lamp, and the correspondence is submitted to show that the company would lose money at that price.

The Sixth Electrical Execution under the State law took place at Sing Sing this morning, when Charles McIlvane paid the penalty of his crime. This was the first execution under the new law granting permission to representatives of the press to be present, and was apparently a success, death having taken place, it is stated, within 4 minutes. There were two contacts, one of 13 seconds and one of 15, the first having been made through the hands. The number of victims of the chair does not decrease, as Recorder Smyth this morning sentenced Carlyle W. Harris to be put to death by electricity, during the week beginning March 21, 1892.

American Institute of Electrical Engineers.—The 64th meeting will be held at the headquarters of the Institute, 12 West Thirty-first street, New York City, on Tuesday evening, February 16, at 8 o'clock. A paper will be read by Lieut. F. Jarvis Patten, on "A Proposed New System of Alternating Direct Current Transformation." Members who are especially interested in this subject may secure advance copies upon application to the secretary, which will be forwarded at the earliest possible moment. Members are invited to contribute their remarks in writing, in case they are unable to be present. The council will meet in the secretary's office at 5 P. M.

Social Gathering of Western Union Officers.—The annual socia lgathering of the officers of the Western Union Telegraph Company took place at the Holland House last Saturday evening. Dr. Norvin Green presided. At his right Vice-President and General Manager Thomas T. Eckert was seated, and at his left Erastus Wiman, one of the directors of the Western Union, and also president of the great Northwestern Telegraph Company of Canada. The executive, scientific and mechanical departments of the company were represented by their respective chiefs. The following were present as invited guests: Isaac H. Bailey, John S. Wise, William Henry Smith, Colonel Finley Anderson, James B. Townsend, Dr. Charles Inslee Pardee and E. P. Mitchell. After dinner speeches were made by Dr. Green, Charles A. Tinker, W. C. Humstone, Thomas P. Clark, R. H. Rochester, R. C. Clowry, W. J. Dealy, Mr. Wimann Colonel Anderson, Mr. Bailey, Mr. Wise and General Wager Swayne.

Trolley on Sixth Avenue.—It is reported to-day that the Metropolitan Traction Company has leased the Sixth avenue surface railroad in this city for a period of 999 years, and its present earnings have been guaranteed. It is also reported that the trolley system will be substituted in place of the present horse power, if permission to do so can be obtained, which is considered possible from the fact that an arrangement might be made with the "L" road by which the wires could be placed under its structure, which would do away with many objections that might arise against the trolley system. The Metropolitan Traction Company was organized in 1891 to operate the roads controlled by the Broadway and other companies. It operates the Broadway, the Houston, West Street & Pavonia Ferry, and the Twenty-third street surface railways. The company is practically the same as the one which operates the street railways of Philadelphia, and is largely owned there. W. L. Elkins and P. A. B. Widener, of Philadelphia, are the moving spirits in the company. Ex-Secretary of the Navy Whitney, Daniel S. Lamont, Henry Thompson and W. B. Dinsmore are representatives of the New York interest.

The Tropical American Telephone Company, of 95 Broad street, New York, owing to the favorable nature of the new trade reciprocity treaties, regards the outlook for the demand and introduction of electrical goods in the West Indian islands and various countries of the Spanish Main as most favorable, and the company has already established agencies in Barbadoes, Jamaica, Cuba and Porto Rico. Arrangements have also been made to represent the Hunning long distance transmitter, Bell and Blake sets and Gower-Bell sets, of the Consolidated Telephone Maintenance and Construction Company of London, for the tropical field. Mr. James H. Howard, general manager of the company, states that he has been allowed two more patents covering improvements in telephones and transmitters, which will enable the company in March, 1893, to offer the public a complete set of private line telephone instruments, the transmitters of which will be entirely different from present forms, and will be free from any interference with Blake, Berliner, or Hunning, and that the expired claims on Edison's, Blake's, and other telephones will open the field in a variety of ways, especially Edison's English patent, 2909, of 1877, which expired July 30, 1891. Several other patents expire in 1893, and this fact, coupled with other developments that may be expected, foreshadows renewed activity in this interesting field during the present year.

The State Railroad Commission held a public hearing in the Common Council Chambers in Brooklyn on Feb. 3, upon the application of the Brooklyn City and Newtown Railroad Company to construct the trolley on Franklin avenue. Col. Partridge, president of the railroad company, was present, attended by ex-Judge Morris, his counsel. David M. Stone was present and so was James Rowe, of the Board of Education. Col. Partridge spoke for his company, making a brief statement concerning consents. On behalf of the opponents of the trolley David M. Stone was heard. F. B. Curtis pleaded to be spared from what he called the "clothes line," and said that the Board of Aldermen and the Commissioners were liable to indictment as accessories of murder before the fact for giving the railroads permission to use this method of wholesale electrocution. Colonel Partridge explained the obtaining of consents. The company commenced to get them two years ago, knowing that some improvement must come, but not knowing exactly what kind. He read the form of consent, which expressly mentioned "conductors with proper support." Mr. Brownson wanted the consents filed for 60 days, so that the opponents of the trolley would have sufficient time to examine them. Colonel Partridge objected on the ground of expense and delay. A compromise was finally effected, under which the railroad company was given until to-day to file a list of consents. The hearing was then adjourned until Tuesday, Feb. 23, at two o'clock, at Albany. L. H. H.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
927 CHESTNUT STREET, PHILADELPHIA, Feb. 6, 1892.

G. W. Schultz & Co.—This concern is in the field for broken incandescent lamps, copper wire and scrap copper.

Moore & White Company.—The friction clutch manufactured by this company is meeting with great success, and large sales for the past week are reported.

W. H. Weston & Co.—This firm is prepared to supply quick break and knife edged switches from 25 to 1,000 ampères and reports doing a nice business with the same.

The Pennsylvania Electrical Engineering Company is doing an extensive business in the sale of the "Pennsylvania" lamp, and reports orders from as far north as Canada.

J. W. Parker & Co.—Mr. Parker reports the usual heavy business for the Ball engine. The trouble seems to be in getting the engines made fast enough to supply the demand.

The Philadelphia Engineering Works, manufacturers of steam engines, and steam plate chimneys, has an advertisement in this issue that may interest any one looking for durable work.

The Imperial Electric Company is constantly adding to its line of electrical specialties, and we may expect to see the Imperial occupying a very prominent position in the electrical business very shortly.

The Globe Electric Cordage Works manufactures Oehrle flame and moisture proof cord, which they advertise as the best in the market. It is recommended by the Philadelphia Board of Fire Underwriters.

Mr. T. Yearsley, in his advertisement which appears in this issue, announces a full stock of new and second hand dynamos for municipal and private work. He reports business in his lines for the last month as good.

Mr. Alfred F. Moore reports a rushing business in Bishop rubber covered wire and fire and weatherproof wire for incandescent circuits. This firm also handles insulated electric wire and cables on an extensive scale.

Partrick & Carter, dealers in annunciators, electric gas lighting and electrical specialties, report trade in their line as encouraging. They carry a full line of all these goods and have agencies throughout the West and Canada.

The Howard Foundry and Machine Works, manufacturers of electrical elevators and street track sweepers, will be glad to correspond with street railway companies, and promise attractions in the shape of prices and superior goods.

James W. Queen & Co., dealers in standard electrical testing instruments, report the demand for their goods at this season as very large. We would refer those who are inquiring for these instruments to Queen & Co.'s advertisement in this issue.

Mr. Walter Smith, general manager of the Heisler Electric Company, has just returned from an absence of three weeks in the West. Mr. Smith reports good success for the Heisler apparatus, as his trip was very successful from a financial point of view.

L. F. Seyfert's Sons report the sale of one 50-h. p. Southwark high speed automatic engine to the Consolidated Street Railway Company, of Grand Rapids, Mich. Their advertisement, which appears in this issue, will interest parties looking for motors, engines, etc.

Mr. Otis K. Stuart, who advertises Stuart's fuse wire as "the cheapest that's made and the best," is very much encouraged by the way the Philadelphia trade has taken hold of this wire. He reports a growing demand, and his sales for last week were much in advance of any previously.

Haines, Jones & Cadbury have recently added a new feature to their valuable blast furnace, in the shape of a rubber bulb with valves by which the reservoir can be charged with air. They are also putting these bulbs on their regular plumbers' furnace, which are furnished free of extra charge.

Cutter Electric and Manufacturing Company.—Mr. H. B. Cutter, general manager of this company, has just returned from an extensive trip through the New England States, and also New York, and reports large sales for flexible metal lamp cord, and a very satisfactory demand for reflector shades.

The Novelty Electric Company will in a very short time introduce some entirely new makes of electrical goods. A timely notice will be made in THE ELECTRICAL WORLD when they are ready for the market. Mr. Trump, general manager, reports business in all its branches as remarkably good for this season.

Mr. H. J. Buddy, manager of the isolated department Thomson-Houston company, Philadelphia, reports the following sales: Oliphant, Pa., 650 lights alternating and 35 lights arc; Dunellen, N. J., 300 lights alternating, and Thomas Potter & Sons, 230 lights; Baltimore & Ohio Railroad Company, Pittsburgh, Pa., 35 lights arc and 450 incandescent.

The Weston & Wells Manufacturing Company, manufacturers of wire incandescent lamp protectors, has now completed the manufacture of a number of these protectors. It is apparently a very useful article in places where the globe may be in danger of being broken, such as in factories, work shops, cellars, freight stations and many other places. W. R. W.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Feb. 6, 1892.

The Consolidated Motor Company has moved into new and commodious offices at 77 Bedford street.

Mr. J. D. Wilkes, superintendent of the Brockton Electric Railway, and Mr. Geo. B. Damon, electrical engineer for the Lowell and Suburban Street Railway, were in town on Wednesday last on business for their respective companies.

The Redding Electric Company last week sent out men to put up several watchman's clocks in Virginia, South Carolina and Pennsylvania. They expect to be gone several months, as they have a large number of clocks to place, and orders are received daily.

City Electrician for Salem.—The Board of Aldermen at a recent meeting passed an ordinance establishing the office of city electrician at a salary of $1,250 per year, and adopted a resolution for the annual appointment of a joint standing committee to be known as an electrical committee.

The New England Electric Club held a meeting at the Tremont House Wednesday night last, at which a report of the house committee was read. Owing to the unavoidable absence of several of the members of committees, including the secretary, who was confined to his bed by sickness, the meeting was adjourned subject to the call of the president.

H. N. Bates & Co. have just issued a very valuable little volume entitled "Machinery for Transmission of Power," which should be in the hands of all central station men, and in fact any one interested in machinery for this purpose. This book contains many tables of great value and interest to such, and will be thoroughly appreciated by those fortunate enough to secure a copy.

Mr. Francis B. Hart, of the Massachusetts Electrical Engineering Company, delivered the last of his series of interesting lectures on "Elementary and Applied Electricity" before the Architectural Club, Wednesday evening last, taking the subject "Electric Lighting of Buildings." The lecture proved very instructive, as have his previous efforts, and it is hoped that the series may be repeated at no distant day.

Fenders on Electric Cars.—The West End Company made another test of five different styles of fenders on Thursday last, in the presence of the "Fender" Commissioner, appointed some time ago to test and adopt a suitable fender. Of the five tested it is stated that the "Appleyard" proved the one best adapted for all kinds of work, and this will undoubtedly be the one finally adopted by the West End Company. The Chester Manufacturing Company, 53 State street, are the manufacturers.

New Electrical Company.—Mr. J. C. Habinger, and his brother, N. N. Habinger, and Mr. J. G. Poole, of New Haven, Conn., have recently entered into partnership to engage in the manufacture of dynamos and motors and other electrical appliances, especially a new type of motor which is the invention of Mr. Poole, who is an electrician of repute. The company has been capitalized at $50,000, and a building for manufacturing purposes is being erected, and as soon as completed work will be commenced in manufacturing.

Mr. Chas. G. Burton, representing the Electrical Construction Company, of Chicago, has been in the city for several days in the interests of his company, in connection with the new building which is being erected by the Equitable Life Insurance Company at Des Moines, Ia. Mr. Burton closed an important contract with Messrs. Andrews, Jaques & Rantoul, supervising architects, for the complete electrical equipment for the building, engines, dynamos, wiring, etc. The contract is an important one, and Mr. Burton is to be congratulated on successfully closing the same for his company.

Pittsfield, Mass., is rapidly growing to be an important centre in electrical manufacturing. New companies are being formed and several of the old companies are adding to and improving their plants. The Stanley Electric Company has recently purchased land for an addition to its plant. The Stanley Laboratory has been started by Messrs. Stanley and Whittlesey, J. F. Kelley, W. R. Plunkett, C. C. Chesney and W. B. Tobey. The company has organized with Wm. Stanley, Jr., president, and W. A. Whittlesey, treasurer. The company will devise and dispose of new electrical devices, working principally in conjunction with the Stanley Electric Company. A large number of skilled electricians have recently located in the city and are identified with new companies.

The Electrical Engineers and Mechanics' Association of Massachusetts held its annual ball Tuesday evening, Feb. 2, in Boston. About 500 couples were in attendance. The decorations of the hall were very elaborate, and the electrical display a feature worthy of note. Six hundred electric lights were used in illuminating the hall, and were arranged in a manner to produce a most brilliant effect. In the centre of the ceiling was suspended an electrical device representing Franklin's historic kite, which is also the association's emblem. From this hung streamers of vari-colored bunting, from which electric light bulbs of red, green, blue and white were pendent. Opposite the main entrance glittered the word "Welcome," while over the platform was suspended the name of "Edison" in electric light of several hues. A ring of lights also encircled the clock in the centre of the hall. By operating different switches, the light in the hall could be changed to any one of the four colors used in the electrical decorations, and from two electro-calcium lights at the ends of the hall various shades were thrown upon the dancers on the floor. The following, among other invited guests, were present: Mayor Matthews, Inspector of Wires B. S. Flanders, Deputy Inspector William Godfrey Mr. Charles Gates, of the Boston Electric Company; Supt. William Atkins and Manager William H. Hills, of the Edison Illuminating Company; Fire Commissioners Murphy, Fitch and Innes, Chief Webber and Dr. Graham Scott, of the Scott Electrical Works, New York City. The Massachusetts Electrical Engineers and Mechanics' Association aims to unite all workers in the various branches of the electrical business for the purpose of mutual benefit, instruction and progress. It has been but two years in existence, yet has accomplished a great deal in electrical educational work for its members, and its roll of names is steadily increasing. C. A. B.

The Perkins Lamp Company, of Manchester, Conn., is unusually busy, and the demand for its popular lamp is constantly increasing.

Mr. F. S. Ball, who represents the Jewell Belting Company of Hartford, Conn., in New York and Pennsylvania, and is well known by central station people in that territory, is in Hartford for a few days.

The Johns Pratt Company, of Hartford, Conn., held its annual meeting on Feb. 2. The old directors and officers were re-elected, and the usual quarterly dividend of two per cent. declared.

The Mather Electric Company, of Manchester, Conn., through their Chicago agents, have just imported a Mangin search light, the same as used in naval vessels, of 35,000 c. p., from France, for the steamer Virginia of the Goodrich Transportation Company, plying between Chicago and Milwaukee.

The National Electrical Manufacturing Company, of Milford, Conn., is bringing out several new novelties which will no doubt command a ready sale. The export business of this company has grown largely during the past year, and, as the company becomes better known in foreign countries, is constantly increasing.

The Hart & Hegeman Manufacturing Company, since locating in Hartford about one year ago, has been favored with a most gratifying business, which is constantly increasing. The five and ten ampère single pole and 15 and 30 ampère double pole switches which this company manufactures have been so well received that a new 60 ampère double pole switch will soon be brought out.

Mr. A. H. Pease, the well known treasurer of the Hart & Hegeman Manufacturing Company, of Hartford, Conn., was united in wedlock to Miss Smith, daughter of Mr. James A. Smith, Jr., a member of the well known firm of Smith, Northam

& Robinson, on January 20 last. After a short trip, which included several of the principal cities, they will return to Hartford, their future home.

The Mather Electric Company, of Manchester, Conn., is constantly adding new and improved machinery to its already finely equipped plant. One of the late additions is a new planer of immense size, furnished by Deitrich & Harvey, of Baltimore, Md. In connection with the same there will be a movable table, which will enable the Mather Company to handle with great dispatch the largest castings made. The company has many orders ahead for motors and power generators.

The Bridgeport Machine Tool Works, of Bridgeport, Conn., is building an extensive addition to its already large plant, The new building will be 100 by 80 in two sections, the west section being two stories high and the east section one story. The work is being done by the Berlin Iron Bridge Company, of East Berlin Conn., and when completed will be substantially fire proof. The building will be heated by the Sturtevant process of blowers made by the B. F. Sturtevant Company, of Jamaica Plains, Mass. Immense traveling cranes will enable the company to remove easily all heavy sections of work from one part of the factory to the other. Skylights eight feet in width on each section will furnish the necessary light. The stranger visiting this thoroughly equipped factory, filled with all the latest improved machinery in the line of boring mills, turret lathes and so forth in process of construction, would hardly believe that only 12 years ago the foundation of the same was started in one small room 87 by 30. But such is the fact, and the success of the company, to quote its words, is due to furnishing the best machinery at a fair price.

L. H. H.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Feb. 6, 1892.

Mr. W. H. Stevenson, of the Stevenson and Hoggson Company, St. Louis, Mo., was in Chicago for a day or two last week.

General Manager Ruebel, of the St. Louis Electrical Supply Company, was in Chicago on Thursday, and said the business outlook was bright and promising.

Mr. F. W. Cushing has been appointed general Western agent for S. A. Day, manufacture of Kerite wires and cables. He has taken an office at 225 Dearborn street.

Mr. P. H. Hover, the western representative of the Standard Paint Company, has opened an office in The Rookery, Chicago, and is making his presence felt among the trade.

Mr. J. H. Reed, formerly with the United States Electric Lighting Company, and the Mather Electric Company, is now with the Chicago office of the Edison General Electric Company.

General A. H. Barney has returned to Chicago, to look after his plan of propelling the boats, gondolas, etc., on the lagoons at the Worlds Fair grounds with the aid of electric motors and storage cells.

The Electric Light Company, of Albuquerque, N. M., has telegraphed an order to the Pond Engineering Company, of St. Louis, for a 100-h. p. Armington & Sims engine, this being the third order within one year.

The Hill Clutch Works, of Cleveland, O., recently obtained a very nice contract for the power transmitting machinery for the Benton & Bellefontaine Street Railway of that city, and also for an extension to the St. Louis & Suburban Street Railway plant.

Mr. Clifford Holbrook, vice-president of the Canton Steel Roofing Company, of Canton, O., is in Chicago looking after the interests of his company. Mr. Holbrook has secured some very large orders for steel roofing and siding and expects an unusually prosperous season.

Mr. George R. Tuttle, a mining engineer, well known in Chicago and Colorado, now located at No. 1,817 Lyons street, San Francisco, Cal., is interested in the application of electricity in mining and has under way the plans for utilizing a heavy water power in the operation of electrical machinery.

The Equitable Gas Light and Fuel Company, of Chicago, Ill., has contracted with the Chicago office of the Pond Engineering Company, for an Armington & Sims engine, to drive a large exhaust fan. This plan is already in use by two other gas companies in Chicago, and is proving very popular in gas plants.

The Hon. George B. Shaw, general manager of the National Electric Manufacturing Company, of Eau Clair, Wis., stopped over in Chicago on Monday. Mr. Shaw is a gentleman whom it is a pleasure to meet, and impresses one by his display of that energy which is typical of the energetic successful Western business man.

Mr. F. H. Leonard, president of the Electrical Engineering and Supply Company, of Syracuse, N. Y., is one of the welcome visitors in Chicago this week. Mr. Leonard's thorough and systematic business methods, and his liberal and progressive ideas in meeting the desires of his customers for improved devices, has enabled him to build up a business that is a credit to his company.

Mr. Allan C. Balch, manager of the great electric power plant at Portland, Oregon, stopped over in Chicago on his way east, where he will inspect the various types of generators with a view to selecting two of the largest capacity, before returning. Mr. Balch is meeting with the same success in business circles that followed his management of local organizations at Cornell, where he was stroke oar in one of the winning crews.

Mr. J. B. Wallace, Jr., president of the Electrical Supply Company, was in the city a few days during January. Mr. Wallace devotes the larger part of his time to the interests of the company's extensive factories in Ansonia, Conn. He is very well satisfied with the volume of trade for 1891, and is so favorably impressed with the outlook for the coming year that additional facilities will be arranged for, principally to increase the output of the well known Shield Brand wire.

"**An Unparalleled Record.**"—The Lindell Railroad, of St. Louis, is reported to have already run its new Short motor street cars 25 days without the loss of a single trip, and in 450 trips but one trip was lost, due entirely to a defective mechanical brake rigging. The lubricant used on these trips was the Peerless motor grease made by George P. Jones & Co., of St. Louis, a grease that for efficiency and economy is spoken of most highly by street railway superintendents, and was regarded as an important factor in enabling the motors to make the record reported.

Specifications for the arc lights of the electric illuminating plant to be used during the World's Fair have been issued by Chief of Construction Burnham. Bids will be received until March 15, 1892. About 6,000 lamps will be required, 5,000 for interior illumination and 1,000 for lighting up the grounds. All systems and generators of any capacity are eligible. The lessor of the machinery and apparatus is to deliver it free on board of the cars in Jackson Park. Installation, removal, oil, and power will be at the expense of the Exposition company. The general management of the plant is to be under the direction of the Chief of Construction. While proposals for small capacity will be received it is requested that the lessor shall specifically state the terms at which he is prepared to furnish capacities up to 500, 1,000, 1,500, and 2,000 lights or more. The machinery and apparatus supplied may be listed and classified as an exhibit by the Director-General, subject to the general regulations governing exhibits.

F. de L.

Tacoma, Wash., Feb. 3, 1892.

The Commercial Electric Light and Power Company, of Tacoma, has removed its offices to the corner of Tenth and A streets.

The Northern Pacific Railroad, it is thought, will be equipped and running its main line trains by electricity in three years from date.

The Pacific Messenger Company has recently commenced business in Tacoma, under the franchise obtained by Manager J. M. Bell, of the Postal Telegraph Company, who has introduced improved call boxes throughout the city.

The Point Defiance Railway Company, of Tacoma, (electrical), will commence work at once on a brick power house, which will be located adjoining the car sheds. It will be in a position to supply its own electric power as soon as money and men can accomplish it. Allen C. Mason can give information as to equipment to be ordered.

Mr. Frank C. Ross, of Tacoma, will soon begin the construction of a standard gauge electric railway from Tacoma, Wash., to Sumner, a distance of 9 miles. Seven miles of the road as surveyed lie in the unopened Puyallup Indian reservation, but, if Congress does not take action very soon, Mr. Ross will set Indians at work building the section through the reservation, which, he holds, the government cannot prevent

G. R. de V.

News of the Week.

THE TELEPHONE.

The Southern Bell Telephone Company has awarded the contract for building its subways in Atlanta, Ga., to the National Conduit Manufacturing Company of New York. This is the first contract of the kind which has ever been awarded to a conduit company.

Competition in the Telephone Business.—The public will be largely interested in the expiration of the Bell Telephone patent in 1893, and the apparent activity among capitalists looking to the organization of companies to engage in the business foreshadows a lively competition and from which the public should benefit. Several big schemes are talked about, none of which, however, seem to have taken tangible shape; one of which is that the Standard Oil Company intends to enter the field with a company to duplicate the New York Metropolitan Company's system.

A telephone and phonograph experiment illustrating the clearness and power of tone of the phonograph was made recently by A. F. Spencer, of the Star Electric Company, the Connecticut agents for the Edison Company, Bridgeport, Conn. Calling up the telephone operator at Erie, Pa., 700 miles from Bridgeport, Mr. Spencer attached to the wire a phonograph containing musical selections by Gilmore's, Baldwin's Cadet and the Wheeler & Wilson bands. The phonograph was then set in motion and was distinctly heard by the Erie operator. Conversation was also carried on with other Erie citizens, and they found it much more difficult to understand than to catch the notes of the phonograph, which were exceptionally clear and pure. The connection was made by way of Syracuse and Buffalo, thus making the distance of 700 miles.

The advantages of long distance telephoning will soon be enjoyed by Cincinnati, it is stated. The Bell Telephone Company has made the necessary arrangements, and all subscribers will be given advantage of the connections. In referring to the matter Captain G. N. Stone, general manager, in his late annual report to the stockholders said: "In view of the fact it is reasonable to assume the long distance telephone lines will be extended to this city within a short time. The long distance lines have already been extended from New York to Pittsburgh, and are in good working order between those points. The company controlling them has secured rights of way in this State and is hurrying the necessary work to rapid completion. Under an arrangement between that company and the local company the long distance lines will be connected to the switchboards of the new telephone exchange in this city, and connections between subscribers in this city and those in New York, Boston and other Eastern cities can be made as quickly as a connection between a subscriber in this city and Hamilton, O., and conversations as distinctly carried on."

THE ELECTRIC LIGHT.

Warrenton, Mo.—An electric light plant has recently been installed, national system.

Sing Sing, N. Y.—It is stated that a new electric light plant is to be erected for city lighting.

Del Norte, Colo.—A new electric light plant is to be put in, bonds having been issued and sold for the purpose.

Monson, Mass.—Parties interested in establishing an electric light plant are canvassing the citizens in regard to the project.

Lake City, Minn.—The City Council has been instructed to get estimates of the cost of putting in and operating an electric light plant.

Creede, Colo.—This new town is to be well lighted, that is, if three companies recently incorporated have the exclusive franchise which they claim.

Waynesboro, Va.—The Town Council has decided that the town should run and operate its own electric lighting plant, and a movement is on foot asking citizens to vote $20,000 for the purpose.

Kalamazoo, Mich.—The City Council has decided that the city should own and operate its own electric lighting plant, and has voted to invite bids for a 200-lamp plant, to be owned and operated by the city.

St. Charles, Mo.—The Mayor has signed the ordinance calling for a special election on March 1 to vote on the question of bonding the city in $10,000 for the purpose of putting in an incandescent electric light plant.

Constantine, Mich.—Local capitalists have formed an electric light company for the purpose of erecting an electric light plant. The Heisler system, it is stated, has been selected, and the plant is to be installed at once.

Cincinnati, O.—Citizens are agitating the question of a municipal electric lighting plant. This, together with the fight over the city electric lighting contract, makes the electric lighting question rather prominent in Porkopolis.

Doylestown, Pa.—The City Council has voted to enter into a contract with the Doylestown Electric Company to light the city for three years, at the rate of $80 per light all night service, after considering the same question for the past five years.

Plainfield, N. J.—It is stated that the City Council is to investigate the charge which has been made that the Plainfield Gas and Electric Light Company has only been furnishing two-thirds of the street lighting service for which the city has been paying under contract.

The Wauwatosa Electric Light and Power Company, of Wauwatosa, Minn., contemplates enlarging its plant, by building a new boiler house, adding new engines and other machinery in order to furnish power for the Milwaukee & Wauwatosa electric road. About $10,000 will be spent for improvements, which are to be completed by June 1.

The Ellenville Electric Company, of Ellenville, N. Y., recently incorporated with capital stock $30,000, proposes to furnish light, heat, and power to light the villages of Ellenville and Napanoch, 2½th miles from Ellenville, where the plant, which will be operated by water power, will be located. The company already has 350 incandescent lights and a few arcs in operation at Ellenville, and when the plant is completed will furnish from 650 to 1,000 incandescent and 50 arc lights.

THE ELECTRIC RAILWAY.

The Love Electric Traction Company, of Chicago, expects to have its trial line on the North Side ready for operation by Feb. 15.

Coatesville, Pa.—Local capitalists are agitating the question of connecting the town with Downingtown by an electric railway, the line to pass through Caln, Gallagherville and Thorndale.

Waterloo, Ia.—The Waterloo and Cedar Falls Construction Company has secured right of way for an electric railway between the city and Cedar Falls, and work will be begun in the spring.

Oakland, Cal.—The Mayor has signed the ordinance granting the Oakland Street Railway Company the privilege to use electricity on its Telegraph avenue line. Work will be commenced at once.

Youngstown, Pa.—Representatives of the syndicate which purchased the Detroit street car lines have been looking over the city, and, it is stated, contemplate putting in a competing electric street car line.

Proposed Electric Road.—The Amsterdam, N. Y., and Rockton Electric Railroad will probably be built in the spring, as it is stated that certain obstacles which have been in the way will undoubtedly be removed.

The Niagara Falls and Suspension Bridge Street Railway, it is stated, may be operated by electricity as soon as the new tunnel is completed, and engineers are making a survey for the route of the proposed electric system.

The "L" Road in Kansas City, Kan., it is stated, is to be changed to an electric system early in the spring. Twenty trains will be put on. The equipment will be the most complete of any road in the country.

Neihart, Montana.—Mr. Geo. W. Brown, of this place, and B. D. Milan, of Sioux Falls, have applied to the Board of Aldermen, for a franchise to construct an electric railway, which they bind themselves to have in operation within six months from date of franchise, if granted.

The Rochester (N. Y.) Street Railway Company has been making a great many improvements in its plant, and placing additional machinery. It contemplates adding another engine and two more generators to its plant, and as soon as the additional power is obtained all the lines in the city will be operated by electricity.

Savannah, Ga.—The amended ordinance granting the street railway companies the right to equip their lines with electricity has passed. It is probable that the Coast line will be equipped electrically, as well as the City and Suburban. It is stated that the Savannah and Isle of Hope lines are to be equipped electrically.

The Louisville (Ky.) City Railway Company contemplates increasing its capital stock, referred to elsewhere in this issue, for the purpose of enlarging its electric plant and making extensions. Mr. J. B. Speed, president of the company, has recently been in the East for the purpose of interesting Eastern capital.

The North Avenue Electric Railway Company, of Baltimore, Md., has won a victory in the Court of Appeals, in the injunction suit brought against it by the North Baltimore company to shut it out from certain street and track privileges. President Whitridge of the company is pleased by the decision, and states that the work will now go on and several extensions be made.

The Indianapolis & Broad Ripple Rapid Transit Company, of Indianapolis, Ind., has been granted until April 1, to submit to the Board of Public Works any contract or contracts it may have made looking to the construction of the road. At that time if the contracts are satisfactory, a bond of good faith must be made, and the company will be granted until Nov. 1 for the completion of its lines.

For an Electric Road.—Senator Faulkner has introduced a bill in Congress to incorporate the Washington Central Railway Company, which contemplates building an electric road in Washington, D. C. The incorporators are John H. Oberley, Cliff D. Maxwell, John J. H. Hassler, F. M. Goodykoontz, Francis C. Nesbitt, T. H. W. McPherson, Marshall W. Wines, Jno. T. Clements, Geo. S. Charles and C. A. Maxwell.

The Interstate Street Railway Company, of Providence, R. I., it is stated, is making negotiations looking to the extensions of its electric system to Woonsocket and adjoining Massachusetts towns. It is reported that the company desires to purchase the plant of the Woonsocket Street Railway Company, and if negotiations for its purchase are not successful, will apply to the Legislature for charter rights for extending the system to Woonsocket.

The Trolley for Staten Island.—The franchise for an electric street railway, to be operated by the overhead wire system, between Port Richmond and the National Prohibition Park, Staten Island, has been granted by both the New Brighton and Port Richmond boards of trustees. The contract provides that the road shall be constructed and equipped in a first-class manner, that it shall be built to Prohibition Park within a year and extended to Richmond road, along Jewett avenue, within two years, and that 12 round trips shall be made over the road each day between the hours of 6 A. M. and 9 P. M.

Milwaukee's Electric System.—When the consolidation of all the roads in this city is completed and the lines are equipped with electricity, which it is stated will be done within a few months, Milwaukee will have one of the largest and most complete railroad systems in the country. The Villard system is very extensive and comprises already about 125 miles of track, which with contemplated extensions will be increased to 150 miles. The Villard syndicate, which controls these lines, has spent, it is stated, already about

$5,000,000, and will probably spend over a million additional before the system is entirely reconstructed. The weekly pay roll amounts to about $13,000. About 250 cars are operated, with 1,500 horses and mules, 3 locomotives and 3 electric power houses which furnish nearly 10,000 h. p. Nine hundred men are permanently employed.

Rapid Transit between St. Louis, Mo., and Clayton is to be established. The City Council has granted to the Clayton and Forest Park Electric Railway Company a franchise to construct and operate an electric street railway from Clayton to Forest Park, where the road will connect with the Lindell and Forest Park Railway. This company secured a charter from the county over a year ago and everything has been done in the way of preparation for building the road. A franchise from the city alone was wanting. The stock necessary to build and equip the road has been subscribed and partially paid up, and itis understood that work will be begun on the tracks as soon as the weather will permit. A new scheme is also under consideration which will bring Clayton into easy communication with St. Louis, and will greatly benefit the residents along that line from the city limits to Crève Cœur Lake. The scheme comprehends an entirely independent electric accommodation train system between Forsythe and Crève Cœur Lake, connecting with the Lindell and Forest Park line.

LEGAL NOTES.

H. K. Thurber Sues the Jarvis-Conklin Company.—The Jarvis-Conklin Mortgage Company, with offices in New York, Chicago, Kansas City and San Francisco, has been sued for $100,000, in the Superior Court, at Chicago, by Horace K. Thurber, of the Thurber-Whyland Company, wholesale grocers, of New York. The litigation grows out of a deal with an electric railway company, at Ogden City, Utah, in which Mr. Thurber claims that he was defrauded out of his just due.

In the suit of the Brush-Swan Electric Light Company of New England against the Brush Electric Company, Judge Coxe, of the United States Court, has entered a decree dismissing the cross bill of the defendant and deciding that on Oct. 15, 1890, complainant was entitled to receive from defendant, upon an accounting, the sum of $18,516.62, which amount was ordered paid. Complainant was also adjudged entitled to retain the sum of $10,725.49, paid to it prior to Oct. 15, 1891, by defendants as a condition of being permitted to make sales. A permanent injunction was also issued against defendants, enjoining them from selling any dynamo, electric machines or apparatus, whether for electric lighting, electro-plating or otherwise, except in Manhattan Island, Boston, Albany, Bridgeport, Philadelphia and Baltimore, and except for Government use on the Atlantic coast and Long Island Sound. The decree was appealed from and the injunction has been suspended pending the appeal.

Petitions to bring suits were heard by Attorney General Rosendale, at Albany, Feb. 2, on the application of the Fort Wayne Electric Company, to the Attorney-General, petitioning that suit be brought for the removal of Charles C. Bernheim, Charles Sternbach, Abram Herman and Lazarus Levi, trustees of the Manhattan Electric Light Company, of New York City, on the ground of misappropriation of funds; that the affairs of the company had been illegally conducted; and that no accounting had been given to interested stockholders. He also heard arguments on a companion application of Jacob Hirsh that the Attorney-General bring suit against the Harlem Lighting Company, of New York City, and Charles L. Bernheim, Abram C. Bernheim, Henry Bernheim, Clarence L. Gans, Eugene Hammett, Abram S. August and Emanuel Hochheimer, as trustees, to dissolve the corporation. W. B. Putney and Judge Dittenhoefer, of New York City, appeared for the minority of the stockholders on the two applications, which were argued together. W. N. Cohen and I. Meyer, of New York City, appeared for the two electric light companies. The Attorney-General reserved his decision.

PERSONALS.

Mr. Robert McA. Lloyd will lecture on "Accumulators" at the Brooklyn Institute, department of electricity, Friday evening, Feb. 19.

Mr. J. Stanford Brown gave a lecture in the department of electricity, Brooklyn Institute, on Feb. 5, on "The Constant Potential Power Transmission Formula, and How It is Obtained."

Mr. Frank B. Rae, who recently severed his connection with the Detroit Electrical Works, has opened an office at 302 Hammond Building, Detroit, and will engage in the business of electrical engineering.

Mr. Lyman W. Byers, formerly with Walker & Kepler, of Philadelphia, has taken charge of the Pottstown (Pa.) Light, Heat and Power Company, as Superintendent, *vice* Chas. E. White, resigned. Mr. Byers is an electrician of long experience.

MISCELLANEOUS NOTES.

The Indianapolis street car strike is over, having been decided by arbitration, it is stated, in favor of the strikers.

John A. Roebling's Sons' Co. sustained a loss of $150,000 by fire on the evening of Feb. 4, at Trenton, N. J., the three-story brick building used for braiding telephone and electric light wire having been damaged. Four hundred people are thrown out of employment.

Lectures on electricity and its industrial applications before employés is a movement which is being taken up by several electrical manufacturing concerns. The object of these lectures is to familiarize the employés with the theory and principles underlying their every-day work. The Ries Electric Specialty Company of Baltimore has started a series of lectures of the kind and the first in the course was given recently by Mr. Elias E. Ries.

West Indian Reciprocity.—The President of the United States has issued a proclamation in regard to reciprocal trade relations with the British West Indies. It consists of one set of schedules for Jamaica and another for other islands. The schedule applicable to British Guiana, Trinidad, and Tobago, Barbadoes, the Leeward Islands, and the Windward Islands, excepting the Island of Grenada,includes among the articles to be admitted free of all customs duty and any other national, colonial, or municipal charges the following: Belting for machinery, of leather, canvas, or india rubber; steam and power engines and machines, machinery and apparatus, whether stationary or portable, worked by power or by hand, for agriculture, irrigation, mining, the arts, and industries of all kinds, and all necessary parts and appliances for the erection or repair thereof, or the communication of motive power thereto; steam boilers and steam pipes; telegraph wire, telegraphic, telephonic, and electrical apparatus and appliances of all kinds for communication or illumination. The schedule applicable to the colony of Jamaica and its dependencies includes the following: Belting for machinery, of leather, canvas, or india rubber; steam and power engines, and machines, machinery and apparatus, whether stationary or portable, worked by power or by hand, for agriculture, irrigation, mining, the arts and industries of all kinds, and all necessary parts and appliances for the erection or repair thereof, or the communication of motive power thereto. Steam boilers and steam pipes, telegraph wire, telegraphic, telephonic and electrical apparatus, and appliances of all kinds for communication or illumination.

Industrial and Trade Notes.

The Pettingell-Andrews Company, of Boston, electric light and electric railway supplies, have sent out recently calendars for 1892, which are neatly gotten up and are a credit to the firm.

The Kester Electric Company, of Terre Haute, Ind., reports meeting with good success in placing Kester motors, and Mr. A. Irvine, general manager of the company, says that business is very satisfactory.

The electric fan is coming into use in the United States Navy. The Crocker-Wheeler Company, we are informed, has just placed four of its perfected fan outfits in the turrets of the new United States steamer Miantonomoh, to blow the smoke away from the guns.

The Hine Eliminator Company, of New York, is in receipt of another order for an eliminator from the Battle Creek, Mich., electric company, W. A. Foote, general manager. Mr. Foote recently made the declaration that he would not set up another engine without the eliminator.

Messrs. A. & F. Brown & Company, manufacturers of pulleys, hangers and shafting, remind their customers that they will remove their office and salesrooms from 44 Park Place to 17 Dey street, New York, quarters formerly occupied by the Edison Machine Works, in the same line.

The National Carbon Company, of Cleveland, O., manufacturers of carbons for electric arc lighting, has sent out a very neat calendar for 1892. It is a bright bit of advertising for the company, and will be especially useful for central stations, as a moonlight schedule is given for each month and each day of the month.

Mr. Ralph A. Schoenberg, of 129 East Sixty-second street, New York, manufacturer of Schoenberg's pneumatic annunciator reset, reports an increasing demand for this device, which consists of an automatic arrangement by which the drops of annunciators may be easily reset by a simple pressure of the hand.

The Emerson Electric Manufacturing Company, of 1,108 St. Charles street, St. Louis, Mo., has sent out a very well arranged illustrated catalogue and price list of 77 pages. The illustrations show up to good advantage the electric lighting and railway specialties and alternating and current machinery manufactured by the company.

Batzel & Buehler, electrical engineers and contractors and agents for Detroit dynamos and motors, of 29 West Twenty-sixth street, New York, are sending out a very neat and finely illustrated catalogue of 63 pages, giving a description of the electrical apparatus handled by the firm, and containing a large number of testimonials in regard to the efficiency of the same.

The Backus Water Motor Company, of Newark, N. J., manufacturers of patent ventilating fans and motors, are sending out an illustrated descriptive catalogue and price list for 1892. From reports which this company is receiving, there will be a large demand for these goods, and the approach of warm weather will tend to bring out a large number of orders for the same.

The La Roche Electric Works, of Philadelphia, has recently issued a neat general catalogue of electric light and power machinery manufactured by the company. This firm furnishes complete installation of electric light and power plants, and in the catalogue referred to above illustrations of apparatus are shown, with full description of each. The catalogue is very complete, and covers 52 pages.

The Safety Insulated Wire and Cable Company, of 234 West Twenty-ninth street, New York, manufacturers of seamless insulated wires and cables, was one of the successful bidders for furnishing the insulated wire in the equipment of the new operating department of the Western Union Telegraph Company's main office, a description of which appeared in a recent issue of THE ELECTRICAL WORLD. The contract was awarded by the electrical department after a thorough examination of several well-known makes of wire.

J. H. Bunnell & Co., of 76 Cortlandt street, New York, have sent out the following notice: "For the protection of the electrical trade in general, we beg to notify all parties interested that suits in our behalf are now being prosecuted against infringements of patents on the Burnley dry battery. All persons making or selling dry batteries which in any respect infringe the Burnley patents, under which we are sole licensees, will be held liable for the full amount of damages arising from such infringement, in either manufacturing or selling.

Mr. I. P. Frink, 551 Pearl street, New York, has now on hand a large number of orders for reflectors and reflecting chandeliers in which electric lamps are used, covering all classes of public buildings, and well distributed over the States, among them the following prominent churches: Protestant Dutch Church, New York City; Christ Church, Jersey City, N. J.; First Presbyterian Church, Fostoria, O.; M. E. Church, Ventura, Cal.; Catholic Church, Owatonna, Minn.; Fourth Presbyterian Church, Pittsburgh, Pa.; M. E. Church, Plainfield, N. J.

The Interior Conduit and Insulation Company, of New York, is making large shipments of Johnson switches to agents and the principal central stations in the United States, and states that it is 30 days behind time on orders, one illuminating company alone having ordered 1,100 switches in two days. The company has in preparation a handsome illustrated catalogue setting forth the good qualities claimed for this switch. This catalogue will be issued together with a revised edition of the company's well known No. 4 catalogue, in the course of the next ten days or two weeks.

The Electric Appliance Company reports business prospects very bright, and states that although January had been a very quiet month in the electrical supply business all over the country, it did a largely increased business during the month. The C. E. M. goods seem to have found general favor with the trade, and the Electric Appliance Company is unable to keep up with orders for sockets and cutouts of the Consolidated Company's manufacture. An elegant line of jackknife switches is also shown in single pole, double pole and three pole and throw over, of which a large stock is carried ready for immediate shipment.

The New Process Raw Hide Company, of Syracuse, N. Y., recently received the following letter from the secretary of the Auburn, N. Y., City Railway Company: "We wish to state to you our approval of your patent raw hide pinions furnished by you and now running on our motors here. We have had a nine months' experience with them and find they fill all requirements. Motors equipped with them run a great deal more quiet and they will with ordinary care outlast the metal gears used. They require to be kept free from oils, and the ordinary car equipments can be kept much cleaner in that respect. You are at liberty to use our recommendation and may refer any parties to us whom you may see fit."

An Important Testimonial Letter.—Many of our readers will be surprised to learn that a prominent manufacturer of wire once received a very strong testimonial letter from Prof. Samuel F. B. Morse. Such, however, is the fact, and the letter itself is given in *fac simile* elsewhere in this issue. The letter is dated Nov. 19, 1868, and is addressed to Mr. Austin G. Day, whose name is inseparable from the Kerite wire, with the manufacture of which he was so long identified. This letter is somewhat surprising, from the fact that Prof. Morse was not in the habit of giving commercial testimonials of any kind, and for this reason its value is much greater than it otherwise would be. The letter is an indication of the very high regard in which Kerite wire was held more than 20 years ago.

The Brush Electric Company, of Cleveland, reports the following recent sales and shipments of new equipment: Edison Construction and Supply Company, Erie, Pa., one 45 light, 1,200-c. p. dynamo; Kittanning (Pa.), Electric Light, Heat and Power Company one 50 light, 2,000-c. p. dynamo, 50 lamps; Fred Grieshemier, Chicago, one 30 light, 2,000-c. p. dynamo and one 200 light incandescent dynamo; Vincent & Lair, Aledo, Ill., one 20 light, 2,000-c. p. dynamo and one 600 light incandescent c. p. dynamo; Gogebic Electric Light Company, Hurley, Wis., one 600 light incandescent dynamo; the Incandescent Light and Power Company, Norwalk, O., two 65 light 2,000-c. p. dynamos, one 20 light 2,000-c. p. dynamo and 115 lamps; Park Bros. & Co., Pittsburgh, Pa., one 50 light 2,000-c. p. dynamo and 95 lamps; D. W. Clark & Sons, St. John, N. B., one 45 light, 1,200-c. p. dynamo; the Tuscarawas Electric Company, Canal Dover, O., two 600 light alternating dynamos; Moline Wagon Company, Moline, Ill., one 30 light 2,000-c. p. machine.

Business Notices.

The Mather Electric Motors combine the highest efficiency and workmanship consistent with a reasonable first cost. Perfect automatic regulation of speed from no load to full load. For catalogues and information address E. T. Pardee, agent, 14 Butler Block, Syracuse, N. Y.

A Truth from "Truth."—The New York Central is really first-class in all its appointments. Think of it, it has four tracks laid with the heaviest of steel rails in the most substantial manner, and when you are sleeping or lounging around in one of their superb Wagner cars, and flying along at the rate of nearly a mile a minute, as some of their fast expresses do, you will hardly realize that you are moving, so excellent is the permanent way. A short time ago a special train made the run from New York to Buffalo at the rate of a mile a minute *the entire distance*.

Empire State Express.—The Christmas number of *Harper's Weekly* contains a full-page cut of the "Empire State Express" of the New York Central & Hudson River Railroad. This is the fastest train in the world. The cut was made from a photograph taken by A. P. Yates, of Syracuse, while the train was running 60 miles an hour. It shows distinctly the locomotive, No. 862, and four coaches. It is a perfect picture of the train. Some idea of how rapidly a photographer's camera works may be gained from the fact that a train running at the rate of 60 miles an hour moves 80 feet in a second, and the shutter of the camera has to be opened and closed in the eightieth part of a second in order that the picture be not blurred on the plate. That is quick work, but photography has reached that degree of perfection that it can be done. "The Empire State Express" leaves New York daily at 9 A. M., and makes the run from New York to Buffalo, 440 miles, in 504 minutes, the actual running time being 52½ miles an hour. It is a pleasure to ride in such a train.

The National Electric Light Convention, Buffalo, Feb. 23 to 26.—Are you aware that the next meeting of the National Electric Light Association will be held at Buffalo, Feb. 23 to 26, and will be one of the most important in the history of the association? Owing to the importance of this meeting the railroads throughout the East and West will grant low rates, and the Michigan Central, "The Niagara Falls Route," in addition to making a rate of $18 from Chicago to Buffalo and return, announce that they will have special cars attached to their New York Vestibuled Express, leaving Chicago at 3:10 P. M., Monday, Feb. 22, arriving in Buffalo early the next morning, for the use of delegates and others going from the West. Applications for space should be made as early as possible to Mr. L. D. Heusner, passenger and ticket agent, Michigan Central Railroad, No. 67 Clark street, Chicago, who will also issue tickets at the low rate announced. It should be understood that this low rate is applicable to all who desire to attend, including delegates, members of their families or supply men.

Delegates to the Annual Meeting of the National Electric Light Association at Buffalo will leave Chicago Monday afternoon, Feb. 22, and arrangements are being made for conveying them in special vestibuled sleeping cars attached to the 3:10 P. M. train of the Lake Shore & Michigan Southern Railway, arriving at Buffalo at 7:20 Eastern time the next morning. Any who finds it more convenient to leave later can take the Limited at 5:30 P. M., arriving at 8.40 A. M., Eastern time. Of the half dozen daily trains returning, the most convenient leave Buffalo at 11:50 A. M., 7:20 P. M., and 11:08 P. M., all Central time, arriving in Chicago respectively at 7:35 A. M., 9:30 A. M. and 3 P. M. the next day. It will be seen from the above the trip by this route, in either direction, may be made in a single night's travel, an advantage over any other line of half a day's time saved on the return journey alone. Tickets for the round trip, $18 on the certificate plan; berths, $3 each way; $1 extra going on the limited. For reservations, certificate and any information address John L. Martin, of Committee on Transportation, care of Chicago Electric Club, Chicago; or C. K. Wilber, W. P. A., Chicago.

Through Car to San Francisco.—The through car service established by the New York Central & Hudson River Railroad between New York and the Pacific Coast provides the best facilities ever afforded transcontinental travel. It is announced that on each Tuesday until further notice a palace buffet sleeping car, containing twelve sections of two double berths each, a drawing-room and buffet, will leave New York on the North Shore Limited at 4:30 P. M., and run through to San Francisco on fast overland connection without change or delay at junction points, arriving at destination at 11:45 A. M. the following Sunday. The schedule has been so arranged that the traveler can select any route desired beyond Chicago. Single and round trip tickets sold at regular rates are valid for passage. The cars which have been built expressly for this service are planned somewhat on the style of the Wagner private cars, and are fitted with every convenience for an extended rail journey. Meals are served in dining cars, which are attached at convenient points, or may be obtained *a la carte* from the buffet. For further particulars and copy of illustrated itinerary apply to nearest ticket agent of the New York Central, or address George H. Daniels, General Passenger Agent, New York.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED FEB. 2, 1892.

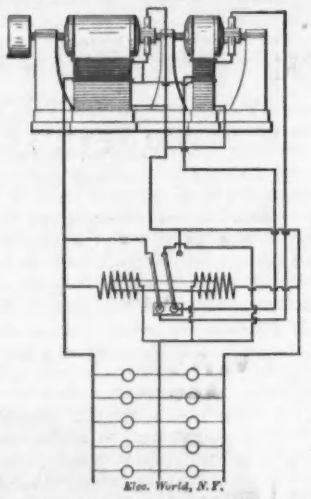
467,917. Telephone Holder; James A. Christy, of San Francisco, Cal., Assignor of part to Bernard Schrafl and F. E. Wait, of same place. Application filed July 12, 1890. A telephone support consisting of a hollow standard, a rod having a vertical adjustment therein and easy rotation or circular movement at the several points of adjustment, and two bars or sections vertically hinged to each other and to the rod.

467,919. Electric Cut-Out; Albert L. Clough, of Manchester, N. H. Application filed Aug. 24, 1891. The combination, with an electromagnet, an armature of said magnet and movable contact pieces severally in suitable electric connection, of a track held on and movable with said armature, a traveler to traverse said track, a movable detent to hold said contact-pieces in and to allow them to move out of contact, and a carrier for said detent.

467,924. Electric Motor; John W. Darley, Jr., of Baltimore, Md. Application filed May 24, 1890. In a regulator for electric motors, the combination, with the armature shaft, of a loose collar mounted thereon, a centrifugal governor revolving with said shaft and connected to said loose collar, and moving the same along the axis of said shaft, a lever connected at one end to said loose collar, and having a fixed pivot attached to one of the bearings of the armature shaft, a horizontal rod hinged at the other end of said lever, a contact roller beneath said horizontal rod, contact plates beneath said horizontal roller, auxiliary resistance coils connected to said contact plates, and a spring connecting said horizontal rod with said lever and pressing said contact roller on said contact plates.

467,940. Trolley-Wire Hanger; Charles Tennant Lee, of Boston, Mass., Assignor of one-half to the Gould & Watson Company, of same place, Application filed March 20, 1891. A trolley-wire hanger having a portion for attachment to a suitable support, a portion having a wire holding device, and a coupling between the two portions, and having insulating material interposed between the ends thereof and the attaching portion and wire holding device.

467,941. Insulator; Charles Tennant Lee, of Boston, Mass., Assignor of one-half to the Gould & Watson Company, of same place. Application filed Sept. 28, 1891. An insulating support for electric wires, comprising two metallic links, each provided with a suitable attaching device, the links being linked together and held out of contact with each other by an intervening mass of insulating material in which said links are imbedded.



NO. 468,122.—SYSTEM OF ELECTRICAL DISTRIBUTION.

467,942. Insulator; Charles Tennant Lee, of Boston, Mass., Assignor of one-half to the Gould & Watson Company, of same place. Application filed Nov. 11, 1891. An insulator comprising an outer case and a rod or stem placed within the said case and insulated therefrom by a series of sheets of mica, and having that portion of the stem which projects beyond the mica in the case partially covered by a series of sheets of mica placed thereon.

467,958. Incandescent Lamp Socket; William L. Silvey, of Lima, O. Application filed May 17, 1889. The combination, with an incandescent lamp globe of a cap mounted thereon and carrying the lamp terminals, and the holder or socket consisting of a cap, a case, a U-shaped insulating piece, to which are secured contact springs, an L-shaped screw plate and a key and stud.

467,969. Electric Railway Motor; Henry M. Byllesby, of St. Paul, Minn. Application filed June 16, 1891. The combination, with an armature mounted upon one of the axles of a car, of rotable field magnets concentric with said armature, gears carried by said field magnets, and gears connecting it with the other axle of the car.

467,982. Incandescent Electric Lamp; David H. Piffard, of Piffard, N. Y. Application filed May 26, 1891. The combination, with an electric lamp and supply conductors connected to the lamp wires, of a solid homogeneous sheath or envelope of an adherent non-conducting moisture proof cement cast around said lamp wires and conductors and adapted to form a tight moisture proof joint both with the glass of the lamp and the said conductors to adhere to the glass and to the conductors and to remain solid under the temperatures to which it is exposed while the lamp is in use.

467,983. Incandescent Lamp Socket; David H. Piffard, of Piffard, N. Y. Application filed June 25, 1891. In a lamp socket and switch, the combination of a continuous tube of soft rubber or similar elastic material, the open end of which forms a socket adapted to hug the lamp-neck closely and form a seal, socket-contacts mounted in position to register with those of the lamp when the latter is forced into the open end of said tube; switch-contacts mounted in closed sealed space at the opposite ends of said tube and connected, respectively, with the socket contacts and the supply wires, and mechanism mounted upon the tube external to the same for compressing same laterally, and thereby operating upon the enclosed contacts of the switch.

467,985. Electric Signal for Mine-Shafts; Frederick W. Bacorn, of Marysville, Mont. Application filed July 28, 1891. The combination, with a mine shaft provided with an electric conductor extending through its length, electrically open at its lower end and connected at its upper end to signaling mechanism, of a cage provided with a hoisting rope capable of conducting an electric current, connecting at its upper end to said signaling mechanism, a trolley from said cage on said electric conductor, a push button within said cage, and connections to the trolley and hoisting rope.

468,020. Electrical Measuring Instrument and Current Direction Indicator; James J. Wood, of Fort Wayne, Ind. Application filed Nov. 3, 1891. A current direction indicator consisting of the combination of an electromagnet traversed by the current, a permanent magnet pivoted within the inductive influence of the electromagnet and having a normal tendency to assume a position transverse to the lines of force of the electromagnet, and a tell-tale connected to and operated by said permanent magnet, whereby it moves to one side when the current passes in one direction, and to the opposite side when it passes in the other direction.

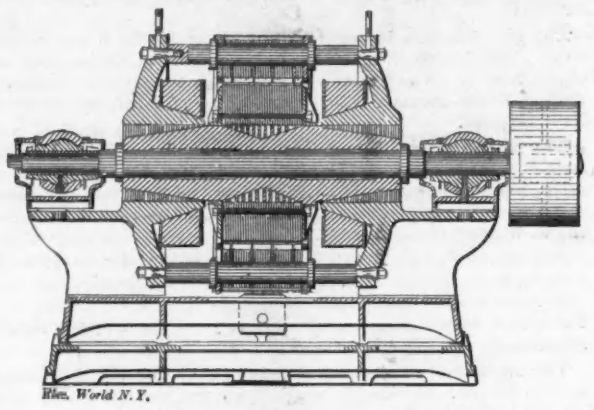
468,053. Insulating Swivel; Axel Helmer Englund, of Chicago, Ill. Application filed Oct. 12, 1891. An insulating swivel comprising a metallic bolt having a body provided with an enlarged head, a covering of insulated material surrounding said body and head, and metallic shackle with a strain collar having an aperture of less diameter than the head of the bolt.

468,086. Electric Wire Coupling; William B. Lillard, of New Orleans, La. Application filed April 20, 1891. A coupling for electric wires comprising two sections, each having a solid shank provided with lugs and a slotted hollow branch having recesses, the lugs being engaged in said recesses when the two sections are united.

468,099. System of Electrical Distribution; Harry Ward Leonard, of New York. Application filed May 12, 1891. The combination of a three-wire distribution system extending over a large area and having continuous current generators at a central station, means for disconnecting a section of the system from or connecting it to the rest of the system, converters adjacent to said section, means for connecting the secondaries thereof to the mains of the disconnected section of the three-wire system, a circuit said converters to the central station, and a suitable generator connected to said circuit. (See illustration.)

468,100. Electric Elevator; Harry Ward Leonard, of New York. Application filed Aug. 31, 1891. The combination of an electro-dynamic motor and a dynamo-electric generator having their armatures electrically connected together and both having separately excited field magnets, means for varying the strength of the field magnet of the generator, and means for reversing the field magnet of the generator.

468,101. Cut-Out; John B. Murphy, of Cincinnati, O.; Mary J. Murphy, Administratrix of said John B. Murphy, deceased. Application filed June 14, 1890. A contact current uniting and breaking device consisting of a contact block, a spring having its



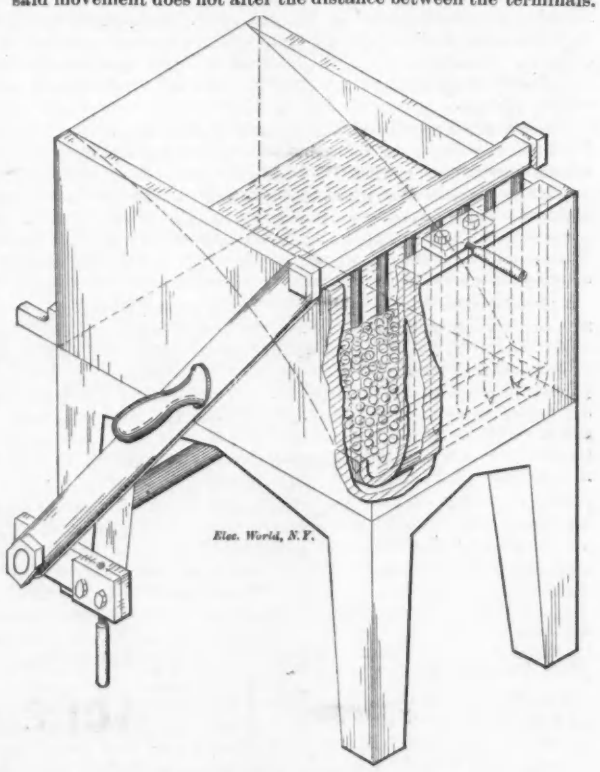
NO. 468,121.—DYNAMO-ELECTRIC MACHINE.

contact end portion adapted to rest on a contact block and having its upper end curved around and fixed to a stationary part, the spring being formed to bear upon the contact block, and when drawn away therefrom to assume a position nearly at right angles to its first position, the free end of the spring being not only out of connection with the opposite pole, but also far below the line of contact with said pole and out of position for recontact to be made therewith until directly lifted by hand and placed upon the contact block.

468,107. Electric Signal System; Howard F. Eaton, of Quincy, Mass. Application filed March 16, 1891. In an electric signal system, a series of signal boxes and a signal receiving instrument and a main electric circuit connecting them, ground branch wires at the boxes and switches for closing them at will, a ground branch wire at the receiving station, and two normally open switches for said branch wire, one of which is controlled by a motor mechanism and the other by an electromagnetic device governed by the main circuit.

468,119. Electric Switch; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed July 14, 1890. The combination in an electric switch of a receptacle containing a conducting liquid of low conductivity in circuit with one of the switch contacts, and balls of better conducting material through which passes the moving contact when opening or closing the circuit. (See illustration.)

468,120. Method of and Means for Interrupting Electric Currents; Elihu Thomson, of Swampscott, Mass. Application filed Sept. 1, 1890. The method of avoiding arcs upon the interruption of electric currents of considerable potential, which consists in causing a rapid movement of the discharge terminals relatively to one another at the interrupted point, such that the said movement does not alter the distance between the terminals.



NO. 468,119.—ELECTRIC SWITCH.

468,121. Dynamo-Electric Machine; Elihu Thomson, of Swampscott, Mass. Application filed Oct. 16, 1890. The combination, in a dynamo-electric generator or motor, of a magnetic core having polar projections forming a divided multipolar consequent pole revolvable about an axis, and the exciting coils surrounding the core to one side of the polar projections, but inside the frame of the machine, with the exterior magnet frame having poles and coils in front of which the consequent pole revolves, and made in sections removable individually, and one or more rods passing through each section, and having ends projecting to the frame of the machine to which they are secured. (See illustration.)

468,122. System of Electrical Distribution; Elihu Thomson, of Swampscott, Mass. Application filed March 11, 1891. The combination, in a multiple series distribution system, of an equalizer coupled mechanically with the main generator and means for automatically shifting the equalizer from one side of the system to another to maintain the balance. (See illustration.)

468,123. System of Electrical Distribution; Elihu Thomson, of Swampscott, and Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed March 19, 1891. The combination, in a multiple series distribution system, of a motor generator returning the excess of energy to the outer mains, with means for altering the relation between the effective lengths of the motor and generator windings by the flow of current over the intermediate wire, and thereby compensating for drop of potential.

468,125. Electric Switch; Augustus Wright, of Providence, R. I. Application filed July 31, 1891. In an electric switch having binding posts and spring contact plates, the combination, with a lever journaled on a bracket and carrying connecting plates insulated from one another and having an extension arm in a line with said lever, of a link pivotally secured to said extension and to a spring operated sliding block movable in a slide.

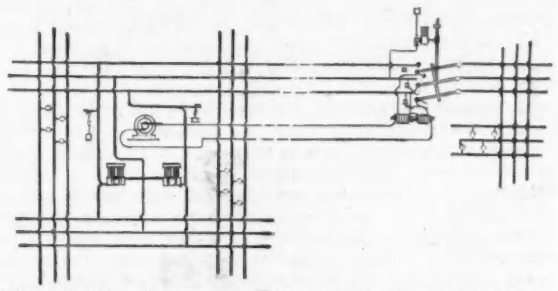
468,128. Electric Motor Regulation; Francis O. Blackwell, of New York, Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed June 5, 1889. In an electric motor, the combination of a sectional field-magnet coil, a switch cutting said sections into or out of circuit, and a resistance connected in circuit between the terminals of said coil-sections, and cut in upon shifting the switch.

468,163. Electric Railway; Malone Wheless, of Nashville, Tenn. Application filed Dec. 1, 1891. A prime conductor or power line, a resistance line, a working conductor, a positive wire, and a negative wire, all three in sections insulated from one another, the sections of the negative wire grounded, the sections of the positive wire connected to the resistance line by feeders in which are electromagnets, and the sections of the working conductor connected with the power line by feeder wires, parts of which are the armatures of the said electromagnets, in combination with a car furnished with a trolley in electrical contact with the working conductor, positive and negative wires, and also provided with a motor, and a switch line connected with the trolley.

468,164. Electric Railway; Malone Wheless, of Nashville, Tenn. Application filed Dec. 1, 1891. A prime conductor or power line, a number of electric batteries, a working conductor, a positive wire and a negative wire in sections insulated from one another, the sections, by feeders, there being in one of the feeders from each battery an electromagnet, and the sections of the working conductor connected with the power line by feeder wires, part of which are the armatures of the said electromagnets, in combination with a car provided with a trolley in electrical contact with the working conductor, positive and negative wires, and also provided with a motor, and a switch line connected with the trolley.

468,165. Electric Railway; Malone Wheless, of Nashville, Tenn. Application filed Dec. 1, 1891. A prime conductor or power line, an electric battery and a supply line running therefrom, a working conductor, a positive wire and a negative wire, all three in sections insulated from one another, the sections of the negative wire grounded, the sections of the positive wire connected to the supply line from the battery by feeders in which are electromagnets, and the sections of the working conductor connected with the power-line by feeder wires, parts of which are the armatures of the said electromagnets, in combination with a car provided with a trolley in electrical contact with the working conductor, positive and negative wires, and also provided with a motor and a switch-line connected with each trolley.

468,166. Conduit Electric Trolley; Malone Wheless, of Nashville, Tenn. Application filed Dec. 1, 1891. The combination of three lines of wire, each line in sections insulated from one another and two of such lines being parts of the same circuit, with a trolley having three pairs of wheels, one pair for each line of wire, and the two pairs which are for the lines of wire in the same circuit being insulated from each other.



NO. 468,099.—SYSTEM OF ELECTRICAL DISTRIBUTION.

468,170. Electrical Annunciator; William Ebert, of Chicago, Ill. Application filed May 20, 1891. The combination, with a casing having a single window, of a number of visible signals, and levers by which they are carried, and armatures carried by said levers, the electromagnets in operative proximity to said armatures, and a separate circuit for each magnet, said armatures being left free to automatically withdraw as soon as the current ceases to flow through the magnets.

468,185. Illuminating Sign; Lawrence J. Webster, of Boston, Mass., Assignor to Bouvé, Crawford & Co., of Mass. The combination with a plurality of signs or sign sections, each provided with an electric lamp, of a base plate of insulating material, a plurality of contact pieces attached to the said base and electrically connected with the said lamps, and a movable plate or segment adapted to be brought into contact successively with the said contact pieces and to remain in contact therewith until after all of the lamps shall have been lighted, and a brush or contact piece adapted to bear upon said plate and to snap off therefrom to break the circuit through all of the lamps simultaneously, after all shall have been for a period in electric circuit.

468,246. Telephone Receiver; Elwood A. Grissinger, of Mechanicsburg, Pa. Application filed May 29, 1891. In a receiver for an electric telephone, the combination, with an outer shell or handle, of a cap having an interior concave surface, a permanent magnet composed of a metallic shell having an interior conical face, its smaller end being thickened gradually by making a portion of the exterior face cylindrical, an induction coil mounted thereon, and a diaphragm between the thickened end of said magnet and the concave face of the cap.

468,253. Electric Elevator; Albert Neunurger, of Kansas City, Mo. Application filed July 31, 1891. In an electric elevator, the combination, with a main line embracing the bare metal conductors in a hoistway, a car, and suitable hoisting mechanism, of a motor circuit, traveling contacts on the car which normally bear on the bare metal conductors, and a reversing switch mechanism arranged to open and close the main line and motor circuit, and embracing a series of movable contacts arranged to successively close different branches of a divided circuit, in which are included different resistances of a rheostat.

468,260. Regulator for Electric Current Generators; Gustav Pfannkuche, of Cleveland, O., Assignor to the Brush Electric Company of same place. Application filed June 22, 1889. The combination, with an electric current generator, a separate exciting dynamo and a resistance included in a shunt around the field magnets of the exciter, of a regulator combined with the shaft of the generator and constructed and adapted to be actuated by the varying load on the generator and automatically vary the resistance in the shunt circuit of the exciter.

468,281. Cut-Off for Telephones; Edwin Cann, of Winnipeg, Canada. Application filed Oct. 3, 1890. A three-wire system of telephone communication comprising a non-electric conductor beam working on a centre pin, a lever with a telephone holder, spring metal plates, a nut and studs and wires.

468,293. Connector for Electric Wires; Clyde J. Coleman, of Chicago, Ill., Assignor of one-half to Albert F. Wineman, of same place. Application filed June 15, 1891. A coupling or connector for electric wires or conductors, comprising an open-sided sleeve having on its inner periphery a series of circularly arranged inwardly projecting teeth that are adapted when the sleeve is compressed to embed themselves into the surface of the wire ends and form both a strong mechanical and perfect electrical connection.

468,314. Conduit for Electric or Cable Roads; Clarence H. Bates, of Minneapolis, Minn. Application filed Jan. 26, 1891. The combination, with a suitable conduit adapted to contain a cable or an electric conductor, and provided with a longitudinal slot or opening adapted to permit a grip or trolley arm to enter the conduit and engage said cable or electric conductor, of a flexible closing strip and yielding supporting devices arranged to hold said strip in said slot, and permitting it to be moved downward and out of the slot and into the conduit as the grip or trolley arm passes along the slot.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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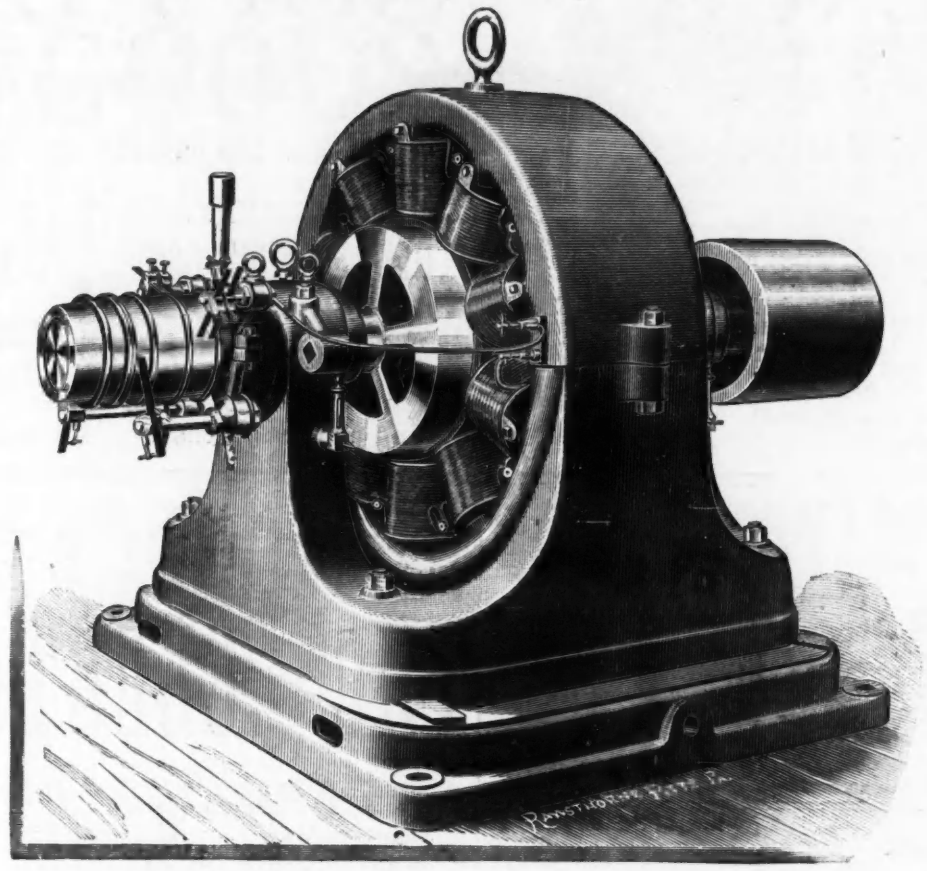

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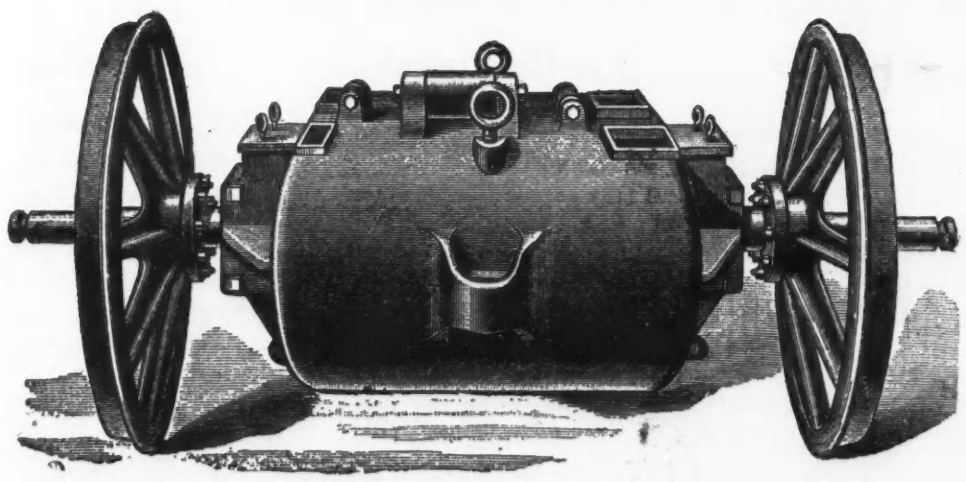

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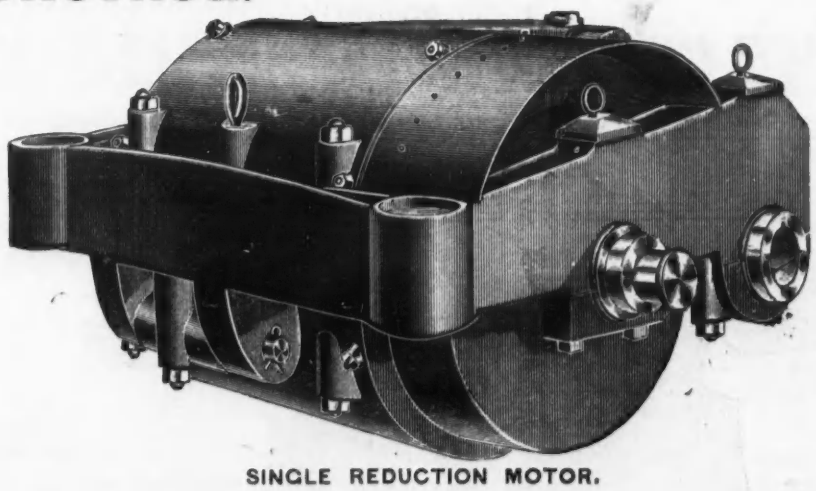

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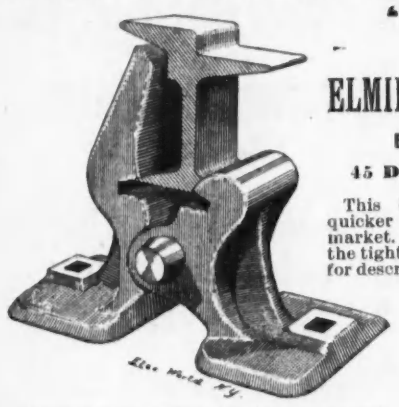

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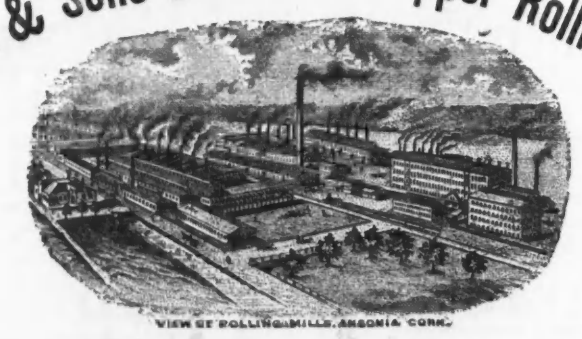

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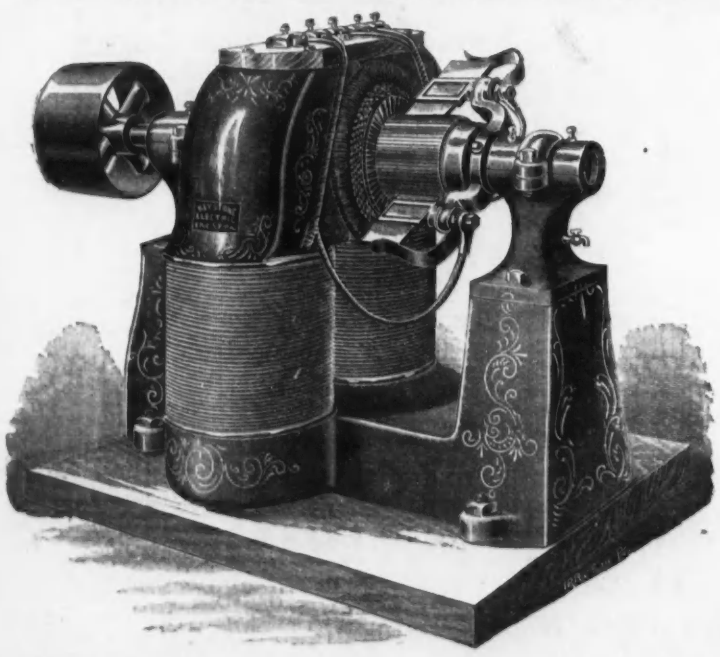

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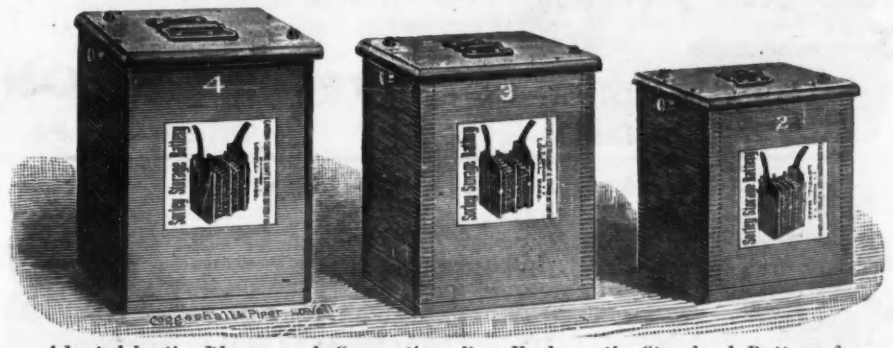

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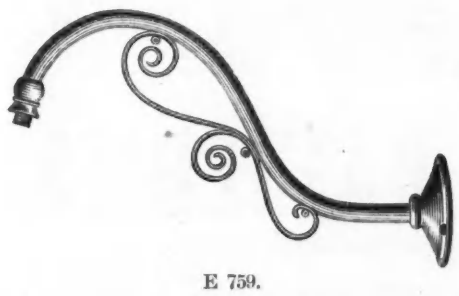

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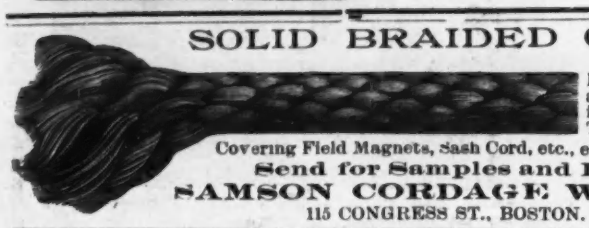

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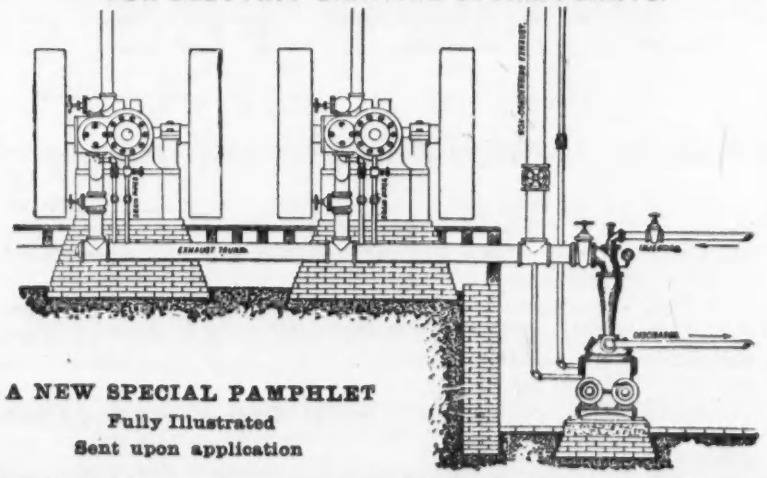

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